

ENSO, the Summer Monsoon and the July-August-September 2011 Outlook for Colorado

Mike Baker
National Weather Service
Boulder, Colorado
June 28, 2011



Topics Covered in this Slide Show

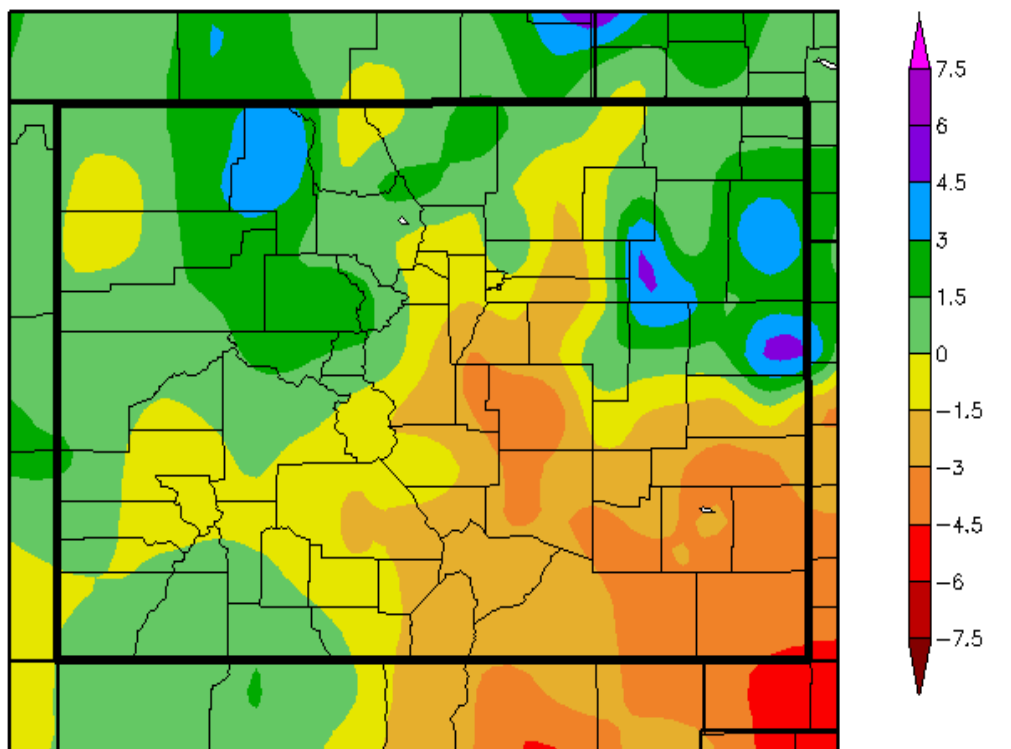
- **Precipitation, temperature and drought conditions across Colorado during the past 90 days**
- **ENSO (El Nino/Southern Oscillation) – its current status and the outlook for ENSO for the next 12 months**
- **For the remainder of the summer – What kind of severe weather will Northeast Colorado most likely see?**
- **The summer monsoon – Will we see one in Colorado and along the Front Range this summer and if so, when, for how long and how strong might it be?**
- **The latest significant wildland fire potential outlook for Colorado**
- **Temperature and precipitation outlooks and historical composites for Colorado for the period July, August and September of 2011**

2011 MARCH 2011						
2011 APRIL 2011						
2011 MAY 2011						
2011 JUNE 2011						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1			1	2	3	4
8	5	6	7	8	9	10
15	12	13	14	15	16	17
22	19	20	21	22	23	24
29	26	27	28	29	30	

Precipitation,
and Drought
Conditions
Across Colorado
During the
Past
90 Days

Departure from Normal Precipitation For Colorado

3/22/2011 – 6/19/2011



Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

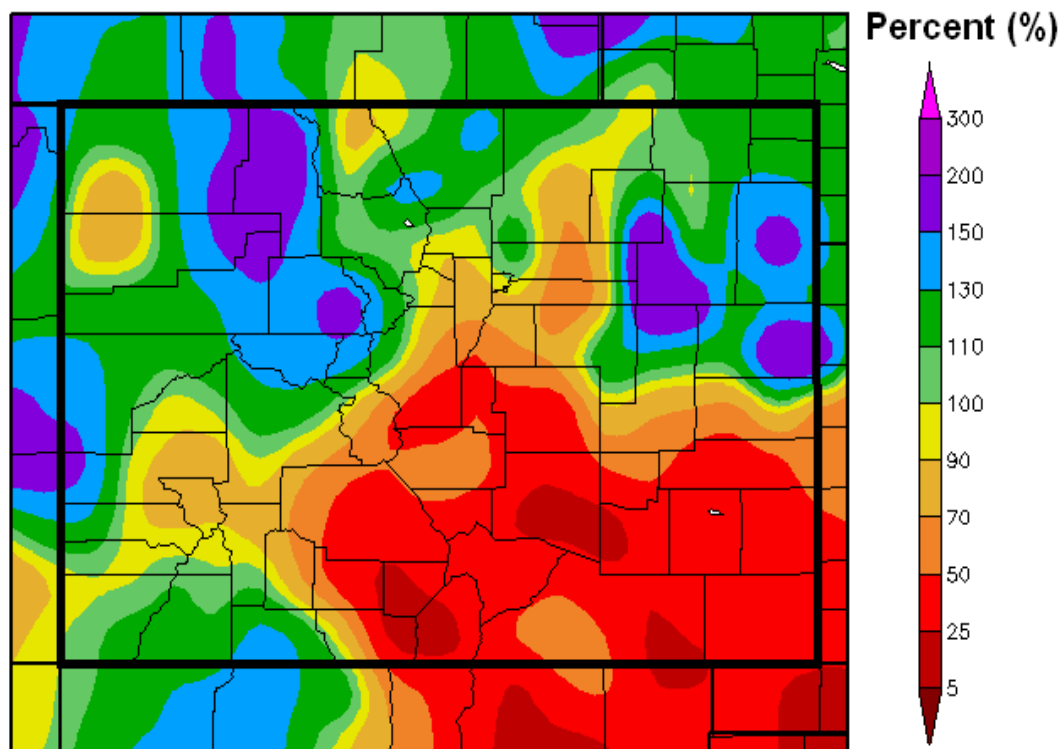
Precipitation across Colorado during the 90-day period ending June 19, 2011 varied widely from as much as 4.5 inches above normal in the upper Yampa River Basin of northwest Colorado, to upwards of 4.5 inches below normal in the southeast corner of the state.

Precipitation was generally above average across west central and southwest Colorado, as well as portions of northeast and east central Colorado.

By comparison, southeast and south central Colorado continued to see below to much below normal precipitation, with the least precipitation recorded in the far southeast corner of the state. In addition, the Palmer Divide region between Denver and Colorado Springs, as well as parts of the northeast plains, also saw below normal precipitation during this 90-day period.

Percent of Normal Precipitation for Colorado

3/22/2011 – 6/19/2011



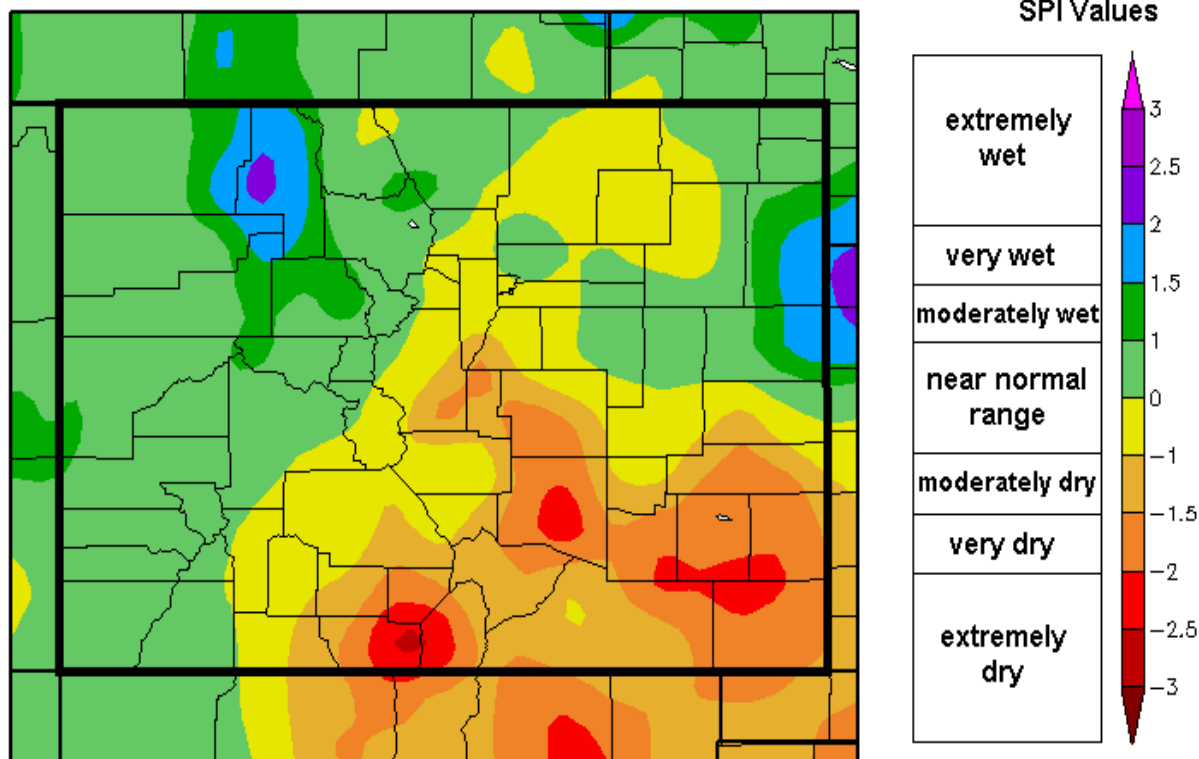
At the same time, precipitation across Colorado ranged from 150 to 200 percent of normal in the northwest centered around Steamboat Springs and across portions of northeast and east central Colorado, to as low as 5 to 25 percent of normal in the upper Rio Grande and Arkansas River Basins in south central and southeastern Colorado, respectively.

Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

3-Month Standardized Precipitation Index (SPI) for Colorado

3/22/2011 – 6/19/2011



Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

For this 90-day period, the **Standardized Precipitation Index (SPI)** indicated very wet to extremely wet conditions for an increasingly smaller portion of northwest Colorado, as well as the northeast plains along the Colorado/Kansas border.

For the remainder of the state, conditions varied from near normal on the western slope and portions of northeast Colorado, to extremely dry on the southeast plains and San Luis Valley.

The **SPI** was developed to monitor potential short term agricultural and long-term hydrological drought conditions. The SPI is a probability index that considers only precipitation.

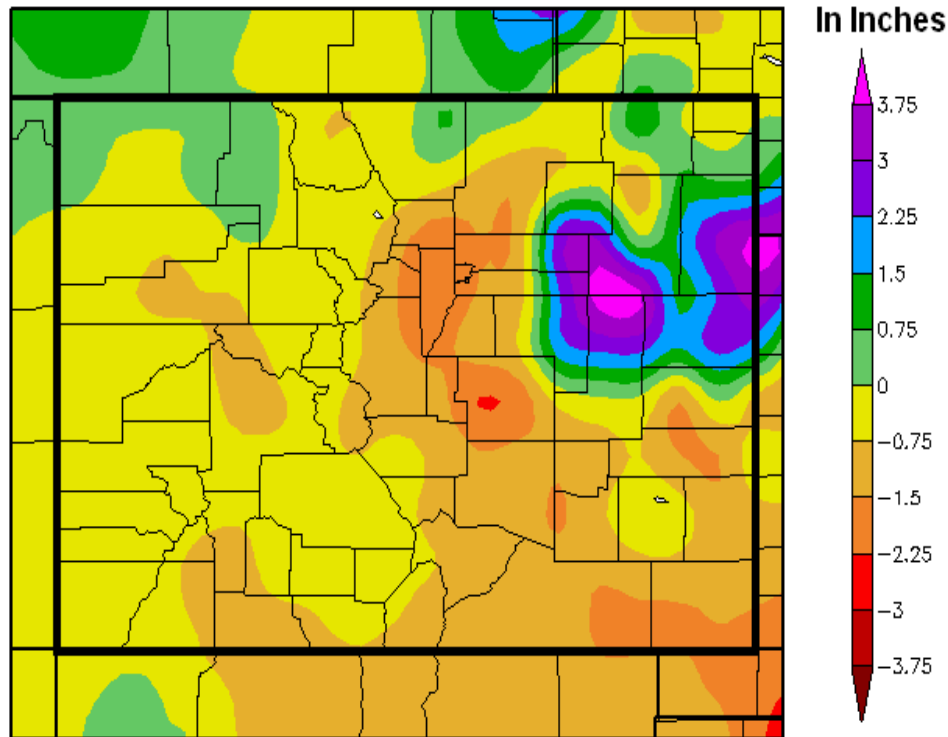
2011 MAY 2011						
2011 JUNE 2011						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Baker NWS Boulder

Temperature,
Precipitation
and Drought
Conditions
Across Colorado
During the
Past
30 days

Departure from Normal Precipitation for Colorado

5/21/2011 – 6/19/2011



During the 30-day period ending June 19, 2011, precipitation across Colorado ranged from a high of 3 to 4 inches above normal across parts of the northeast plains, to a low of 1.5 to 2.5 inches below normal along the southern Front Range, the Pikes Peak region around Colorado Springs, and the Arkansas River Basin in southeast Colorado.

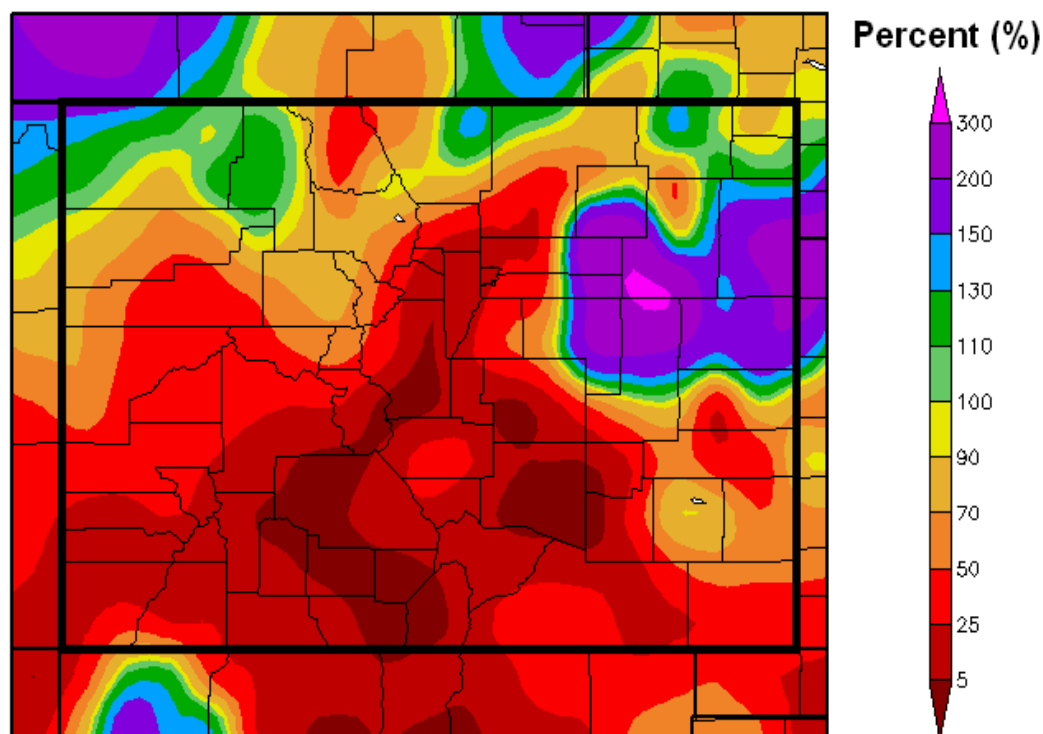
Probably the most significant month-to-month change in precipitation occurred in the Upper Yampa and Laramie River Basins where overall precipitation fell below normal for a second consecutive month.

Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

Percent of Normal Precipitation for Colorado

5/21/2011 – 6/19/2011



During this 30-day period, precipitation across Colorado varied from an impressive 300 percent of normal across portions of northeast Colorado--a reflection of a very wet May, to less than 50 percent of normal across nearly all of southern Colorado, as well as portions of the Front Range and Palmer Divide in northeast and east central Colorado, respectively.

Sections of the Upper Rio Grande and Arkansas River Basins and South Park in Park County received barely 5 percent of their normal precipitation during this 30-day period.

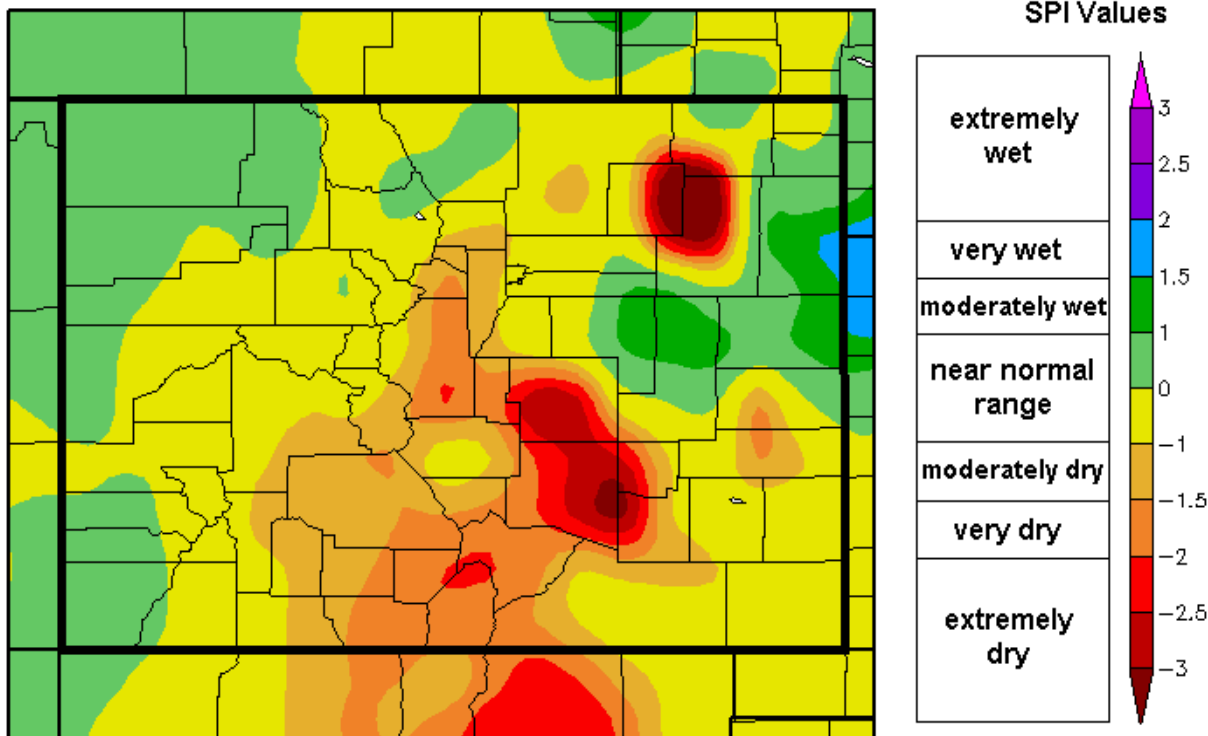
The Laramie River Basin in Jackson County also saw a significant decrease in precipitation, with less than half of the normal precipitation occurring during the period.

Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

30 Day Standardized Precipitation Index (SPI) for Colorado

5/21/2011 – 6/19/2011

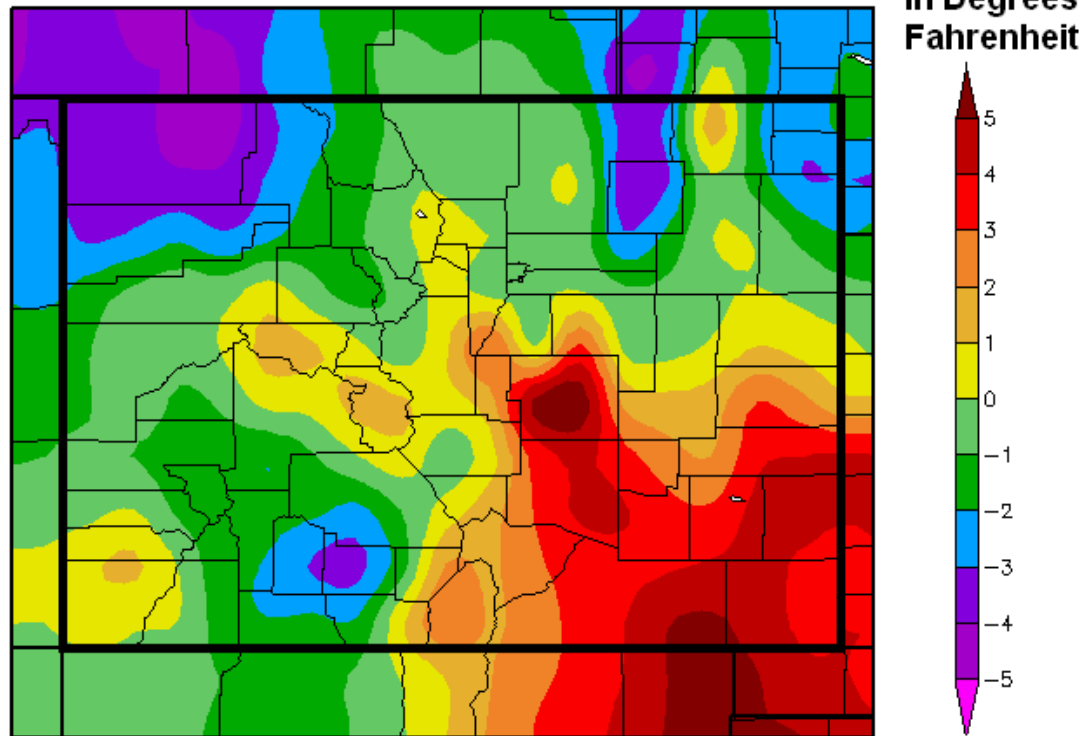


For the same period, the Standardized Precipitation Index (SPI) indicated pockets of extremely dry conditions in eastern Colorado, more specifically central portions of the South Platte River Basin just east of Fort Morgan, along the Interstate 25 corridor from Colorado Springs to Walsenburg and portions of South Park in central Colorado, and at higher elevations of the Sangre de Cristo Mountains in southern Colorado.

For the remainder of the state, near normal conditions were generally indicated.

Departure from Normal Temperature for Colorado

5/21/2011 – 6/19/2011



Generated 6/20/2011 at HPRCC using provisional data.

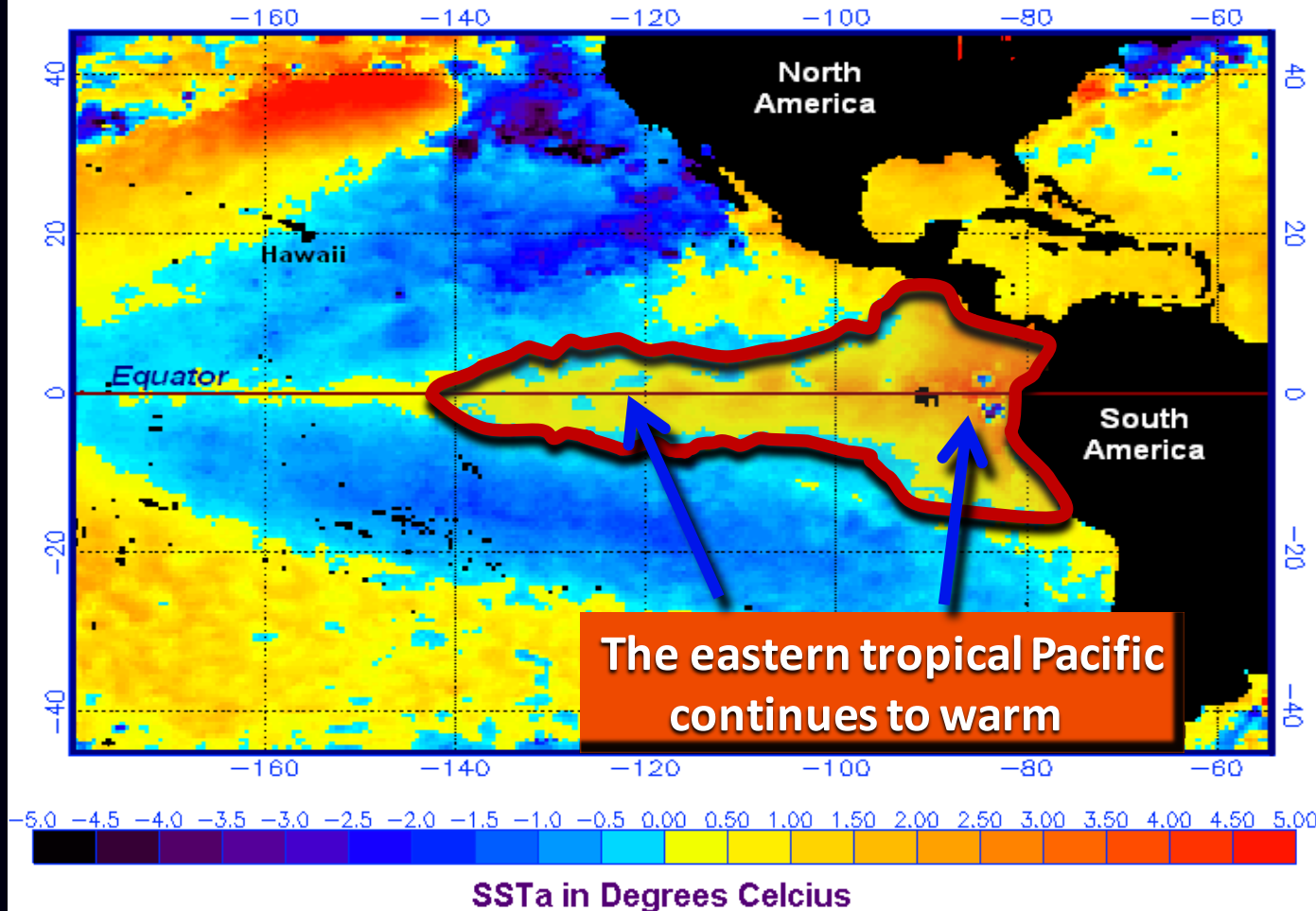
Regional Climate Centers

At the same time, temperatures varied widely across Colorado. Averages ranged from 3 to 5 degrees (F) below normal across most of northwest Colorado, near the head waters of the Rio Grande in the San Juan Mountains and portions of the northeast plains, to as much as 5 degrees above normal in the Pikes Peak Region around Colorado Springs and the far southeast plains.

For the remainder of the state, temperature averages for the 30-day period were closer to normal, ranging from 0 to 3 degrees (F) above normal in central and southeastern sections to 0 to 3 degrees (F) below normal in western and northeastern portions of the state.

La Niña Is No More

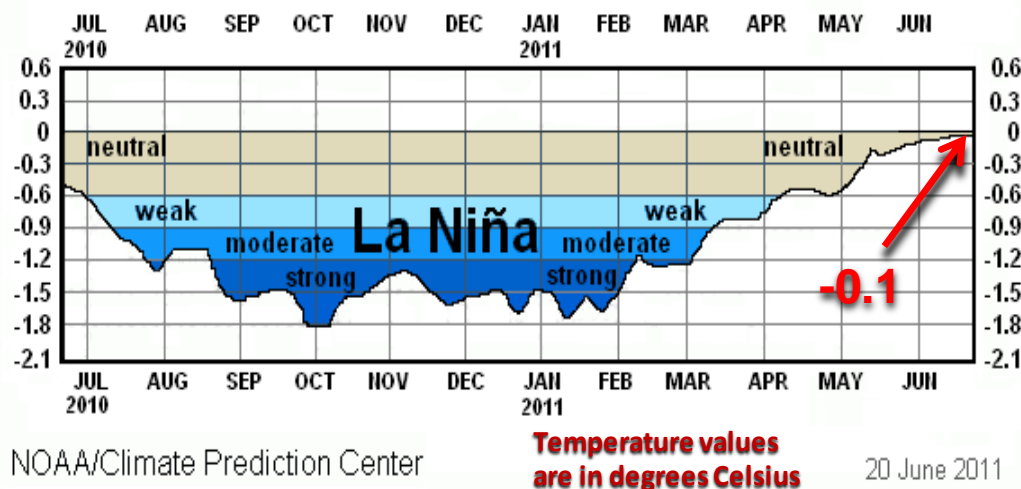
NOAA/NESDIS Sea Surface Temperature Anomaly (°C)
for June 20, 2011



The transition from La Niña to ENSO – neutral conditions occurred this past May.

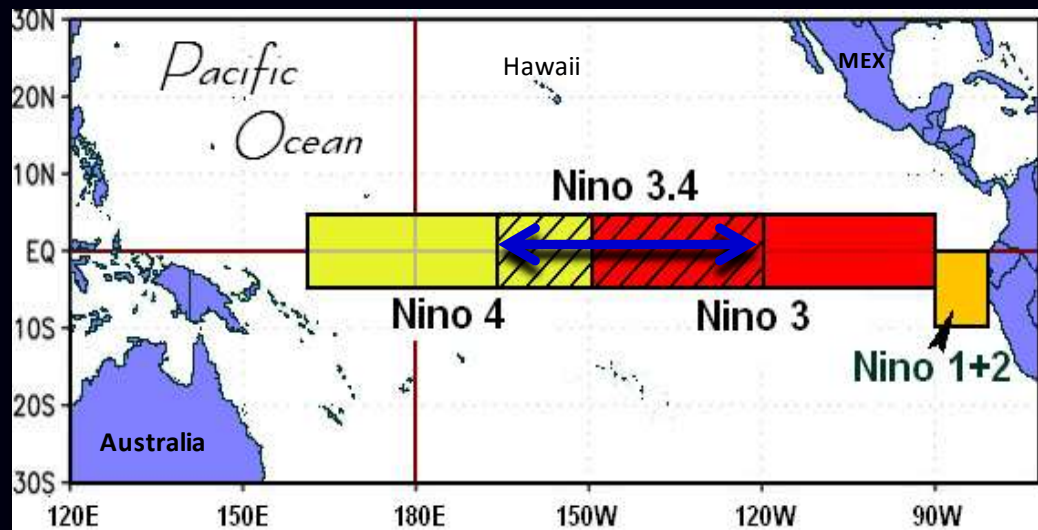
The continued warming and westward expansion of near-average sea surface temperatures (SSTs) across the eastern tropical Pacific Ocean, and the persistence of hemispheric atmospheric circulations consistent with La Niña, are compatible with earlier transitions to ENSO-neutral conditions.

Sea Surface Temperature Anomaly Time Section for NINO 3.4



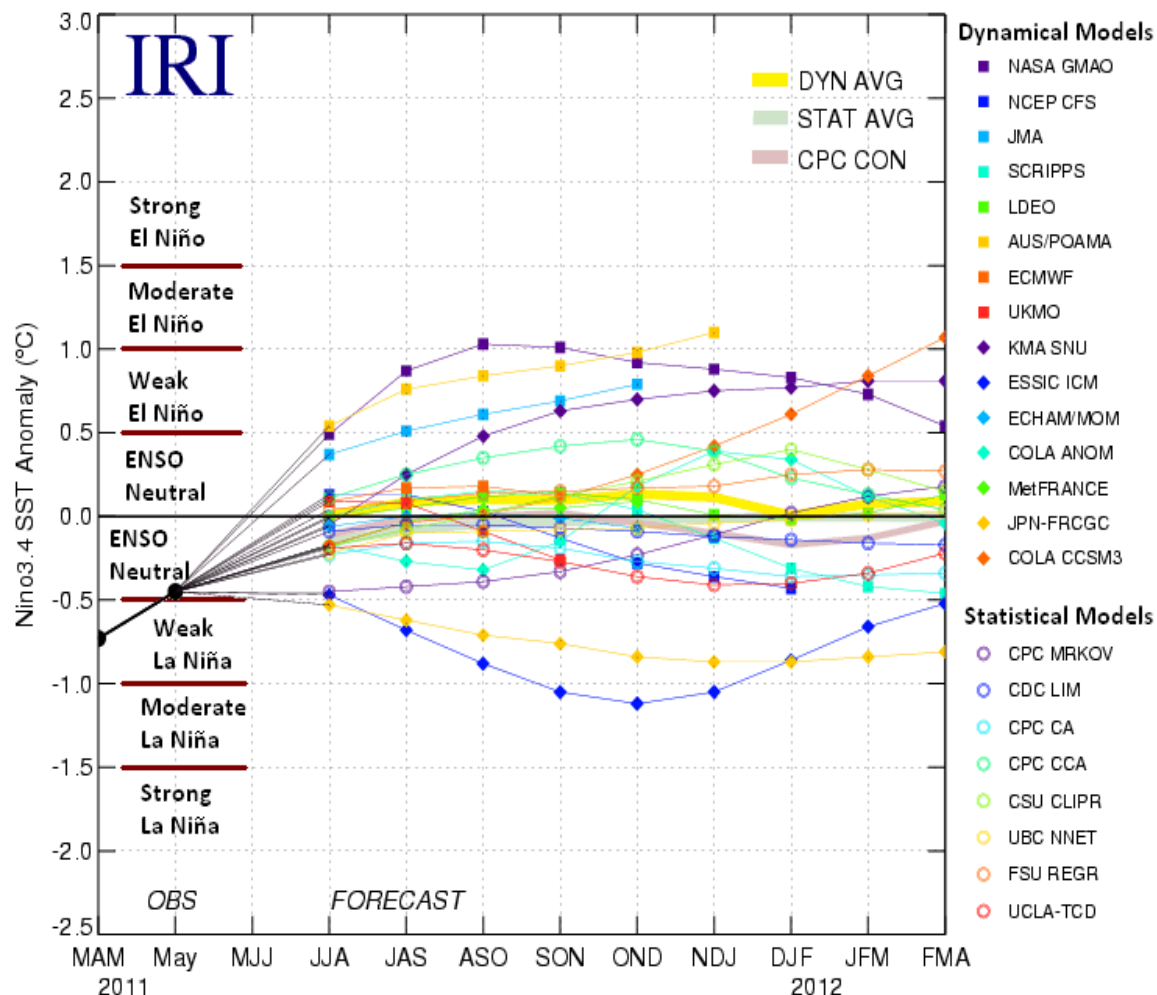
The sea surface temperature anomaly (SSTa) within the Niño 3.4 region of the eastern Pacific Ocean has continued to weaken, and was near-average (-0.1C) as of June 20, 2011.

Niño Region 3.4 in the Tropical Eastern Pacific Ocean



Nino 3.4 – Is the principal region in the eastern tropical Pacific used by the Climate Prediction Center (CPC) for monitoring, assessing and predicting ENSO.

Model Predictions of ENSO from Jun 2011



Since the demise of La Niña (formally of moderate to strong intensity) this past May, ENSO-neutral oceanic conditions have developed across the Pacific Ocean.

Current trends, along with a majority of the dynamical and statistical ENSO models, predict a continuation of ENSO-neutral conditions in the Pacific Ocean for the remainder of 2011.

However, the status of ENSO beyond this summer remains uncertain due to lower model forecast skill that far out in time, particularly during this time of year. Notice that some of these models are already predicting weak El Niño conditions or even a re-emergence of weak La Niña conditions by this autumn.

Source: International Research Institute for Climate and Society (IRI) – Updated 6/17/11

Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1.0	-0.8	-0.6	-0.5	-0.4	-0.4	-0.4	-0.5	-0.6	-0.7
2001	-0.6	-0.5	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0	-0.1	-0.1
2002	-0.1	0.1	0.2	0.4	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.4
2003	1.2	0.9	0.5	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	0.5	0.7	0.8	0.9	0.8	0.8	0.8
2005	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	0.5	0.6	0.9	1.1	1.1
2007	0.8	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	-0.7	-1.0	-1.1	-1.3
2008	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0	0	0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	-0.6	-1.0	-1.3	-1.4	-1.4	-1.4
2011	-1.3	-1.2	-0.9	-0.6								

Latest ONI

El Niños (warm phase events): ONI of +0.5 and higher (red numbers)

La Niñas (cold phase events): ONI of -0.5 and lower (blue numbers)

ENSO-Neutral (near average conditions):

ONI below 0.5 and above -0.5 (black numbers)

An ONI of -0.6 indicated that weak La Niña conditions existed during the three-month climate season of March-May 2011.

The ONI is based on sea surface temperature (SST) departures from average in the Niño 3.4 region of the Pacific Ocean and is a principal measure for monitoring, assessing and predicting ENSO.

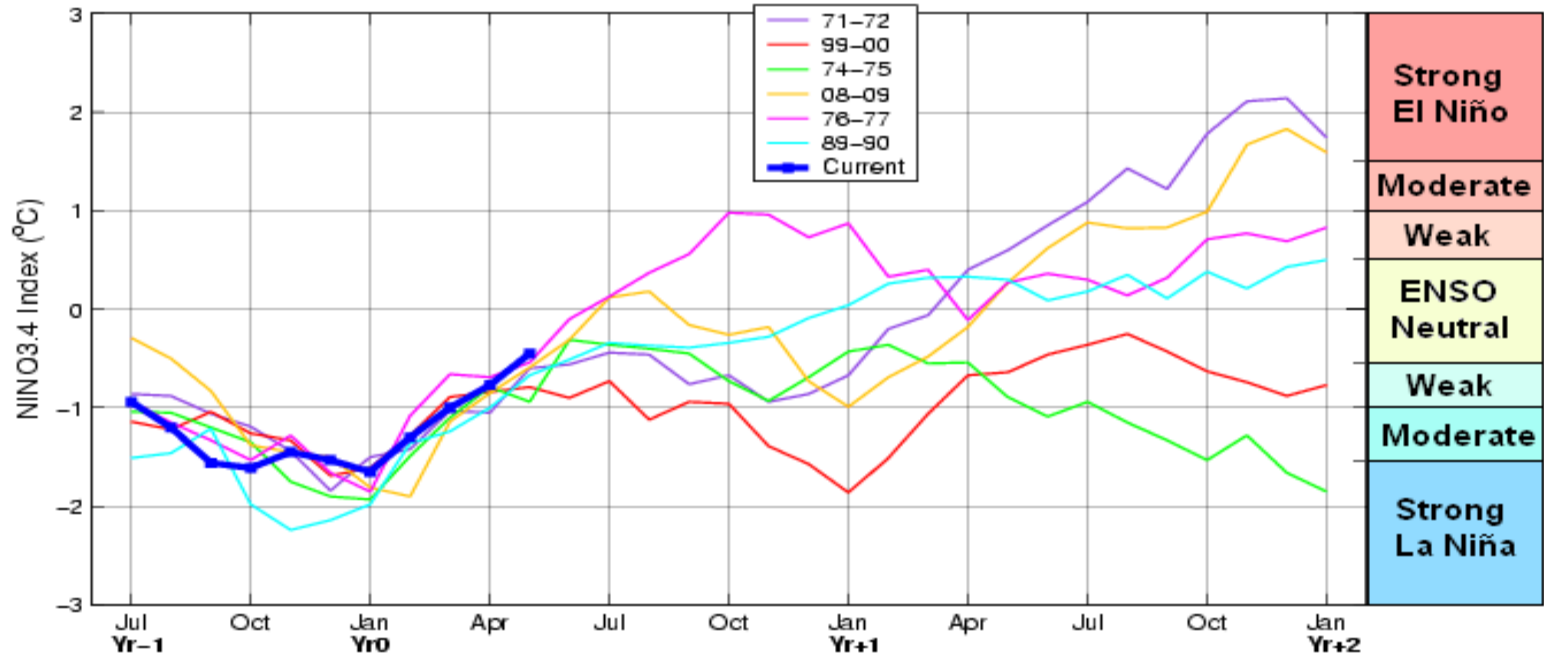
ONI is defined as the three-month running-mean SST departures in the Niño 3.4 region.

ONI is used to place current ENSO and non-ENSO events into a historical perspective.

NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.

A Comparison of the Seven Strongest La Niña Events Since 1970

Current vs. Past Niño3.4 Indices (°C)

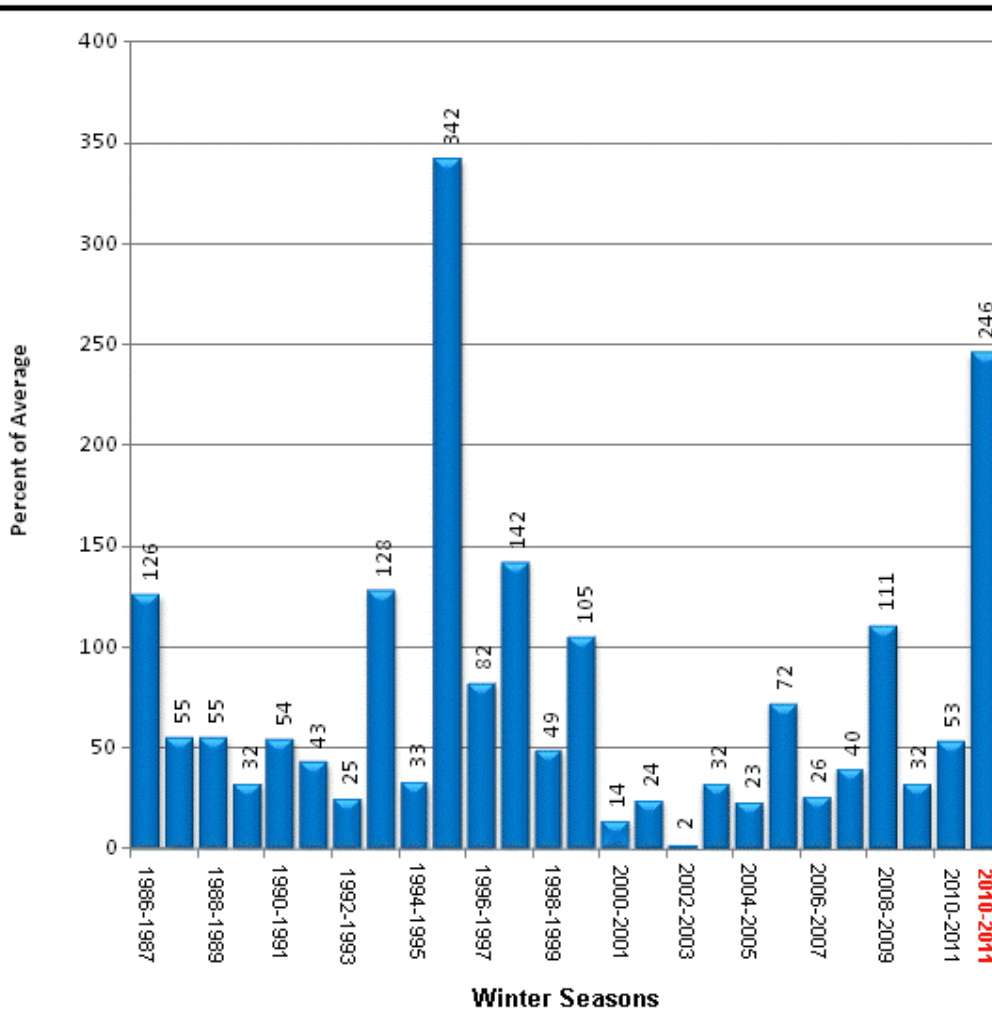


Source: The International Research Institute for Climate and Society -IRI - June 2011

Above is a comparison of the seven strongest La Niña events since 1970. Included with these significant ENSO events is the strong La Niña that ended this past May. All seven events attained their greatest magnitude during December and January, and all seven events weakened at a similar rate from February through the end of April.

Six of these events, including the latest La Niña, continued to weaken at a similar pace through the month of May, with all six transitioning to ENSO-neutral conditions by the end of the month or early June. However, the moderate La Niña during the winter of 1998-1999 managed to remain weak in strength through the summer of 1999, eventually transitioning to a strong cold phase event by the winter season of 1999-2000.

Colorado Statewide Snowpack As of June 1, 2011



Total Seasonal Snowpack for Colorado and Its Eight Major River Basins as of June 1, 2011

Since the winter season of 1986-1987, the Natural Resources Conservation Service (CRCS) has kept a running tally of total seasonal snowpack across Colorado and the Rocky Mountain West.

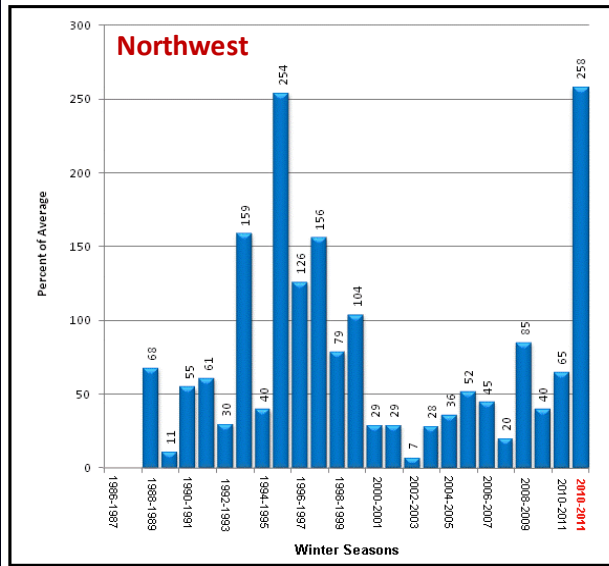
As of June 1st of this year, Colorado's statewide snowpack ranked 2nd to the record breaking snowpack of 1995-1996. Although this winter season's total snowpack occurred in the midst of a strong La Niña, it was still quite impressive at 246 percent of normal.

Colorado Western Slope River Basin Seasonal Snowpack Totals

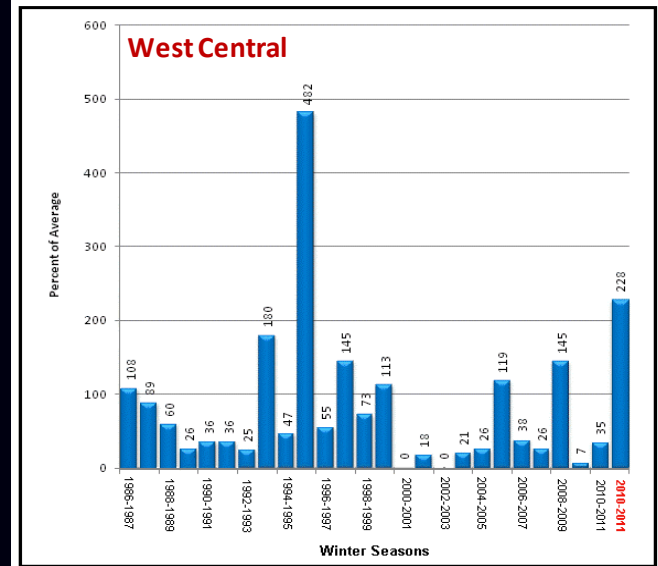
As of June 1st, 2011 Colorado river basins west of the Continental Divide did substantially well with respect to snowpack, especially across northwest Colorado where the Yampa/ White River Basins recorded a snowpack of 258 percent of normal. The Colorado River Basin in west central Colorado also ended the season with an impressive snowpack at 289 percent of normal.

Even the river basins in southwest Colorado managed to end the season with an above normal snowpack, thanks in large part to a very snowy storm track that set up over the region in early spring.

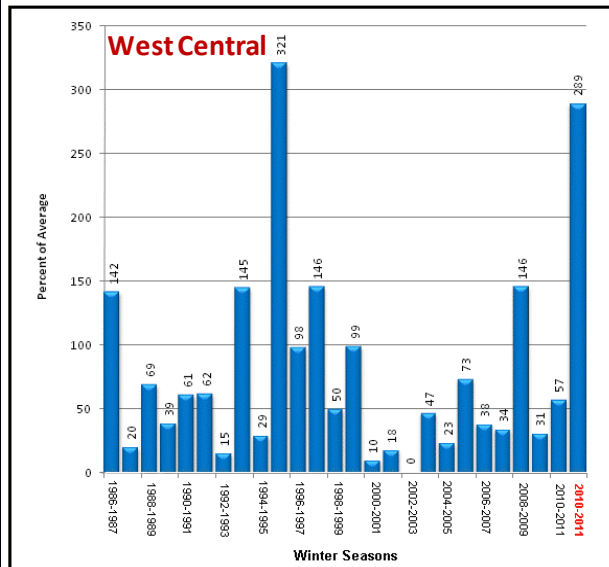
Total Yampa & White River Basins Snowpack
As of June 1, 2011



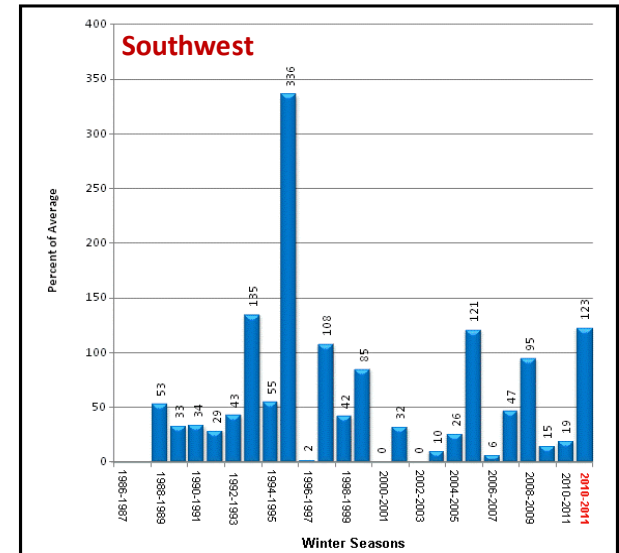
Total Gunnison River Basin Snowpack
As of June 1, 2011



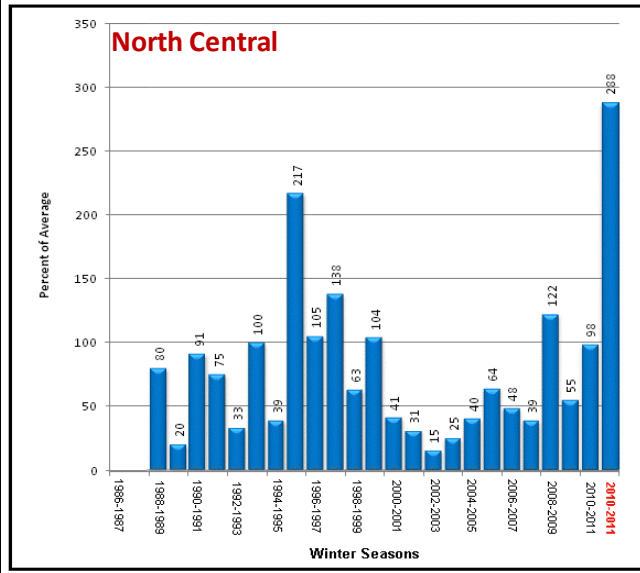
Total Colorado River Basin Snowpack
As of June 1, 2011



Total San Miguel, Dolores, Animas & San Juan River Basins Snowpack
As of June 1, 2011



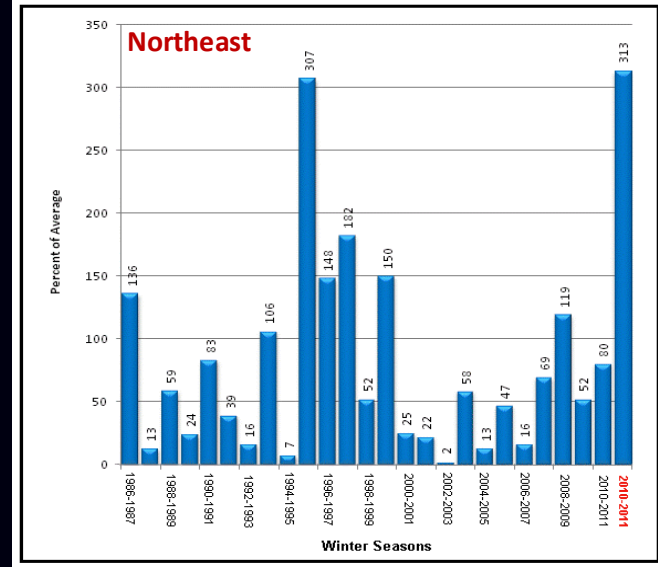
Total North Platte River Basin Snowpack
As of June 1, 2011



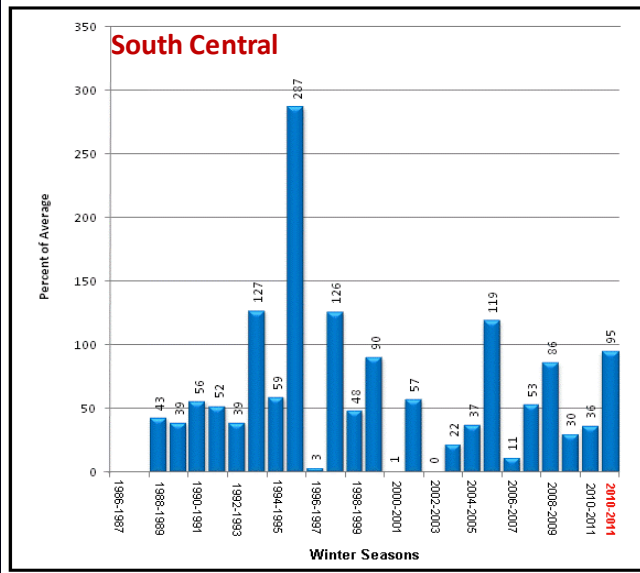
Colorado Eastern Slope River Basin Seasonal Snowpack Totals

As of June 1st, 2011 Colorado river basins east of the Continental Divide also recorded snowpacks well above average, with the exception of the Upper Rio Grande Basin in south central Colorado.

Total South Platte River Basin Snowpack
As of June 1, 2011

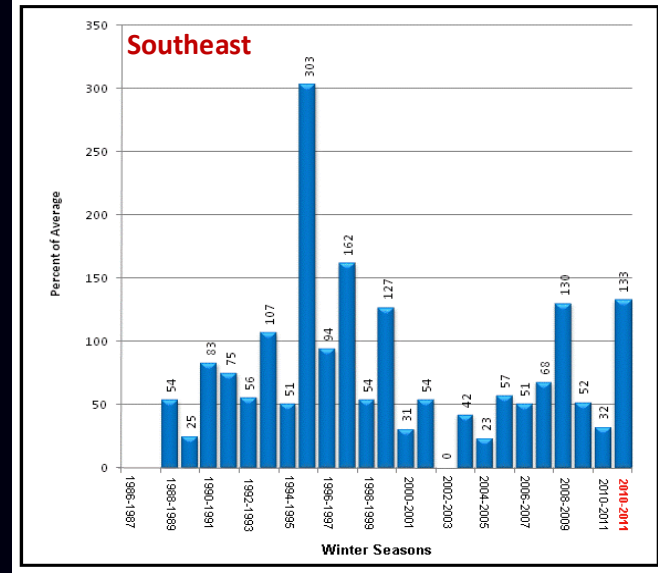


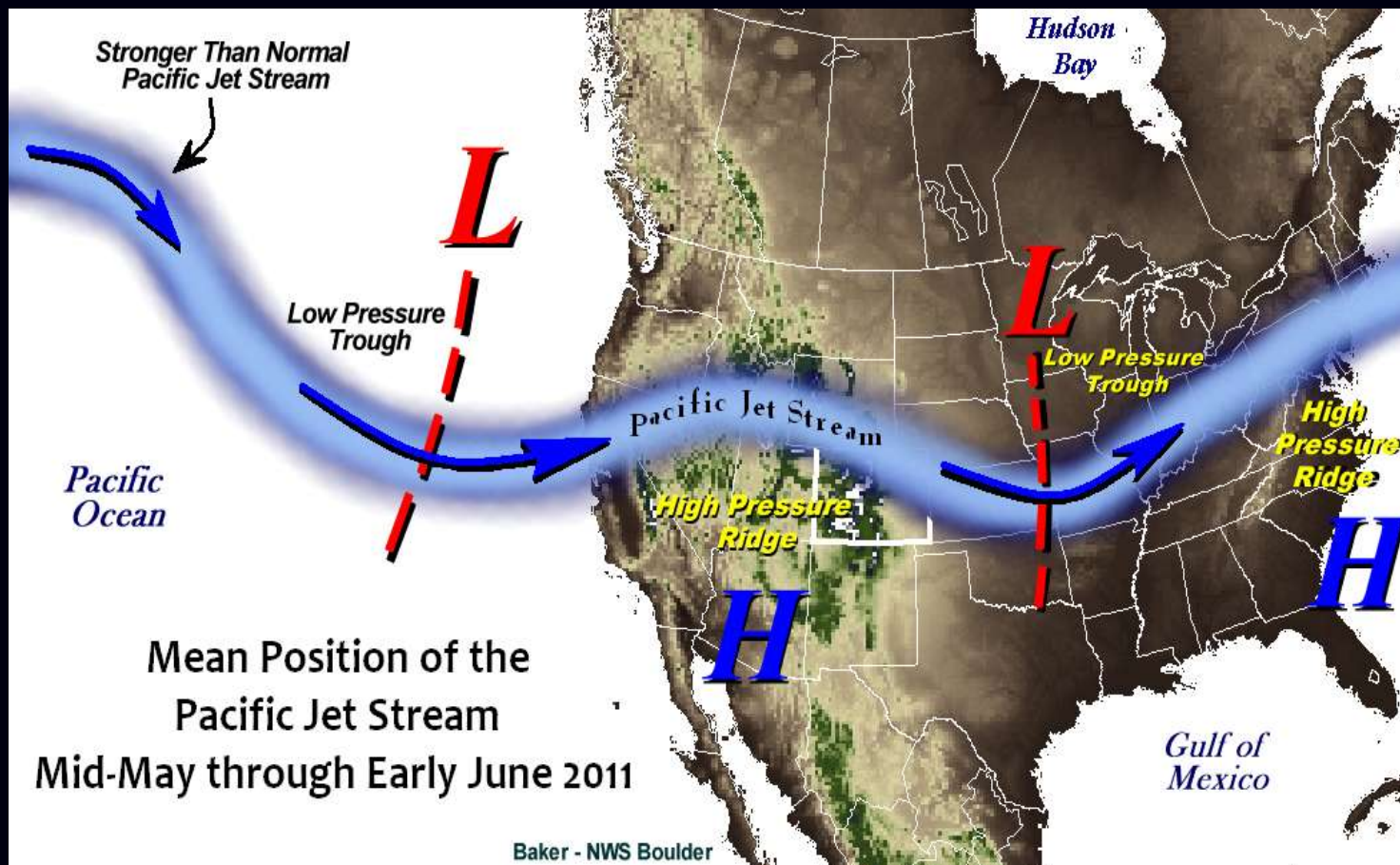
Total Upper Rio Grande Basin Snowpack
As of June 1, 2011



The North Platte and South Platte River Basins in north central and northeast Colorado, respectively, fared especially well. However, the 313 percent of normal total snowpack in the South Platte River Basin is somewhat misleading as this snowpack was based on SNOTEL monitoring sites at mountain elevations generally above 9500 feet ASL. The eastern portion of this basin and the southeast plains saw only a fraction of this snowfall.

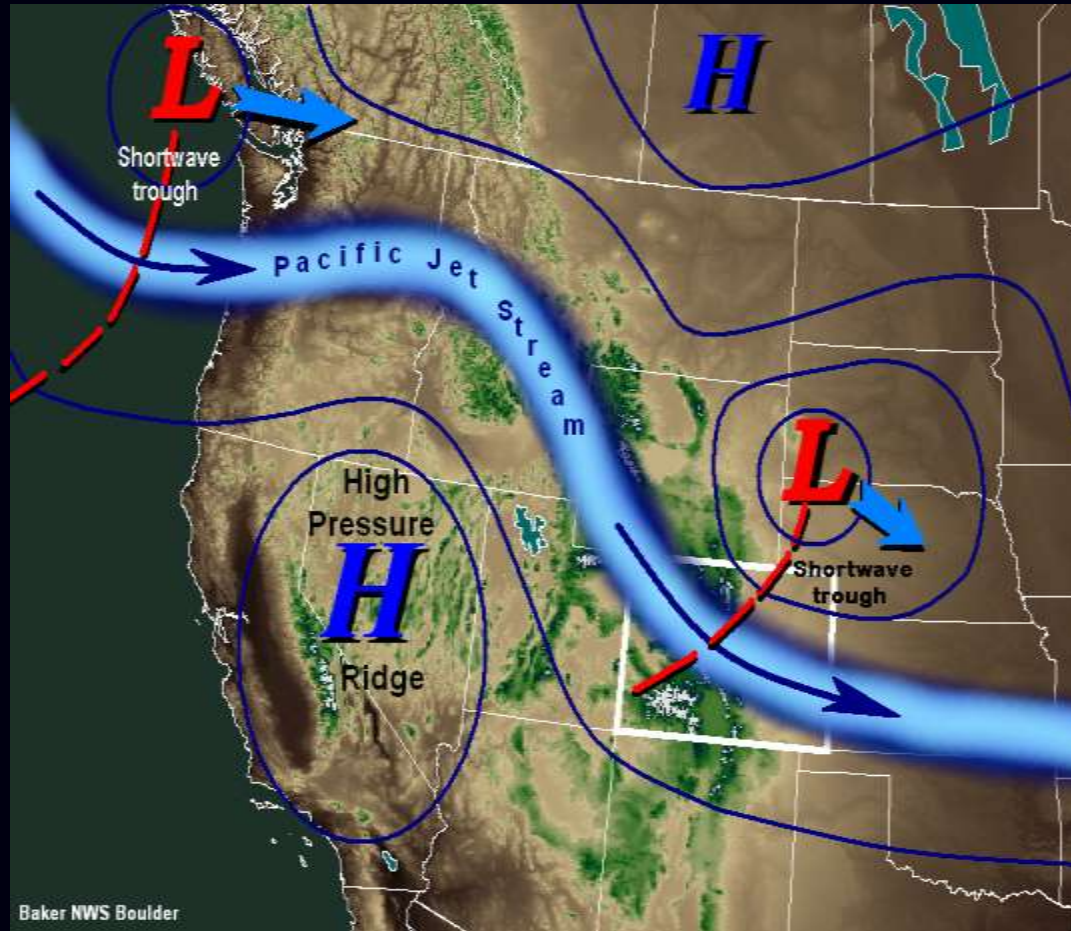
Total Arkansas River Basin Snowpack
As of June 1, 2011





From the middle of May through early June, an abnormally strong Pacific Jet Stream snaked across central portions of the continental U.S. Its unusual strength, persistence and placement--farther south than normal--are believed to have contributed to the widespread and often record-breaking severe weather that battered much of the central and southeastern U.S. this spring. By early June, the jet stream had weakened and shifted northward over the northern tier states as a large dome of high pressure began to build over the southwest U.S. The hot temperatures normally observed across the southwest during June were slow to arrive, due in part, to the close proximity of the Pacific jet stream, a.k.a, the storm track, presumably a lingering affect of the strong La Niña of last winter.

Setting the Stage for a Drier and Shorter than Normal Summer Monsoon




1- During the next several weeks, the Pacific jet stream will continue to weaken with it becoming nearly stationary over the Pacific Northwest and northern Rocky Mountain regions.

2- During the same period, a strong upper level ridge of high pressure will likely form over the Great Basin, resulting in some of the warmest temperatures of the summer across for the desert southwest and intermountain region.

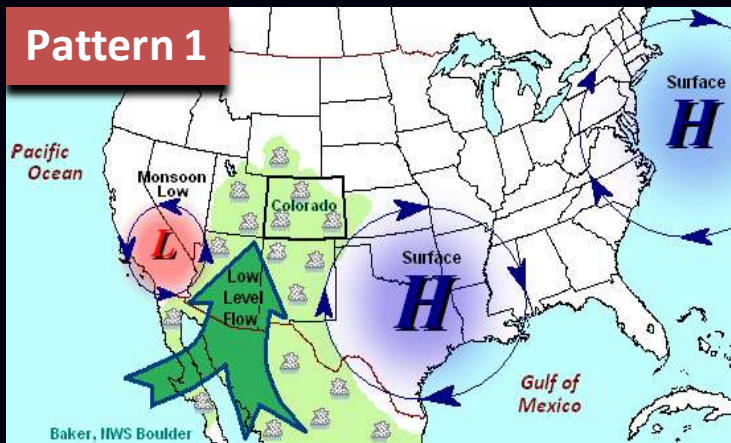
3- As the Great Basin high pressure ridge strengthens and expands southward over the lower deserts of the southwest, weak upper level circulations or shortwave troughs traveling along the Pacific jet stream will drop southeast out of the Pacific Northwest and over Colorado from time to time. Thunderstorms generated in northeast Colorado by this post-La Niña summertime storm track tend to produce large hail, potentially damaging thunderstorm winds and even tornadoes.

4- These same high plains storms are less likely to produce heavy rainfall resulting in flash flooding. Reasons include a relatively dry lower atmosphere east of the mountains produced by this northwest (downslope) flow and their relatively fast movement. Should thunderstorms manage to produce heavy rainfall, they are more likely to do so well east of the Front Range.

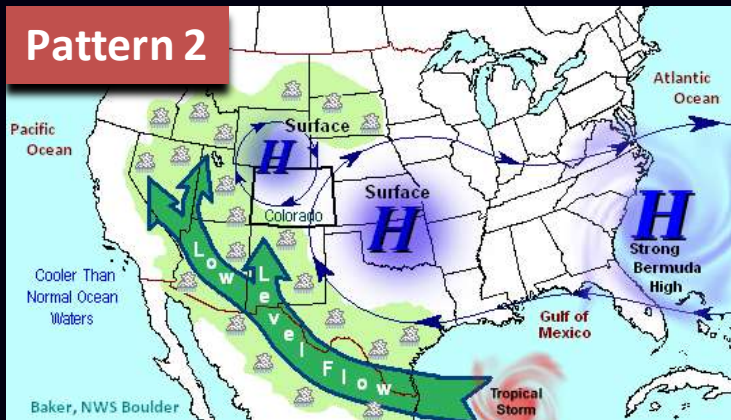


The Summer Monsoon – When, How Long and How Strong?

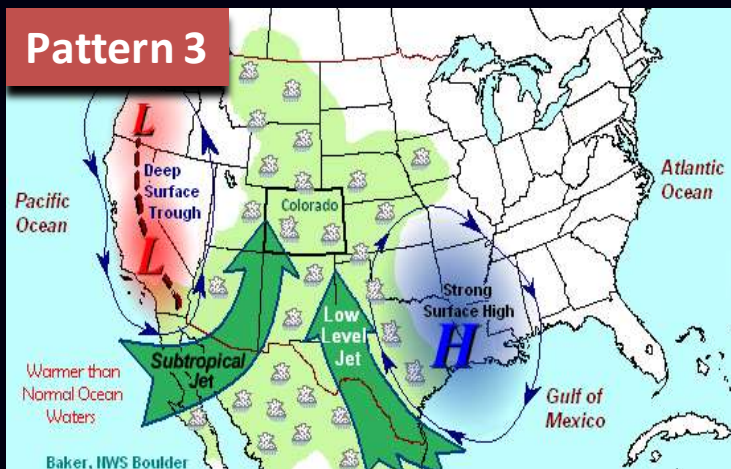
Pattern 1



Pattern 2



Pattern 3



What Monsoon Pattern Could We See This Summer?

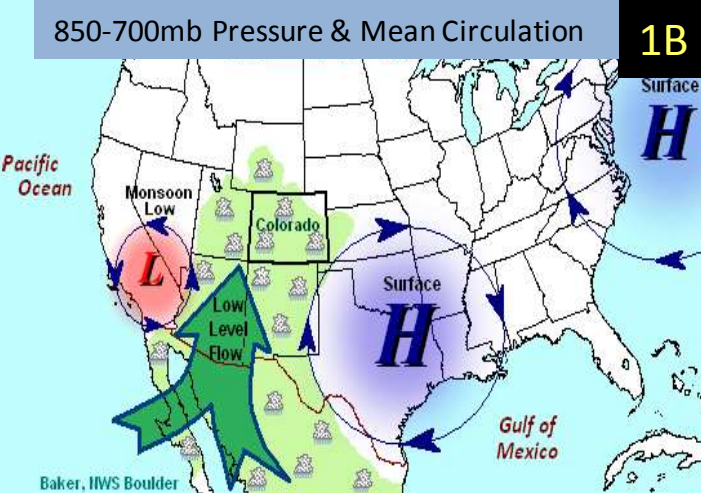
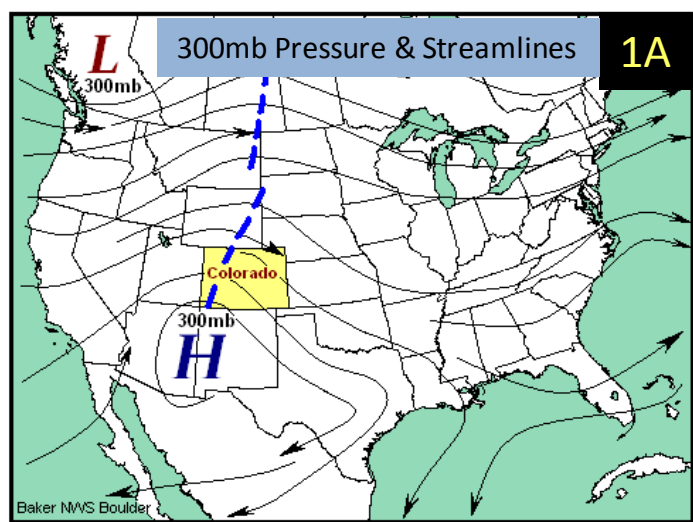
Monsoon - is derived from the Arabic word “mausim”, meaning *season*. In meteorology, the name commonly refers to a *seasonal wind*.

The summer monsoon in the southwest United States is pale in comparison to the greatest monsoon on the planet, the southwest monsoon in India which brings heavy to torrential rains to the Indian peninsula and to much of southeast Asia during the summer and fall.

Each summer, strong solar heating across the southwest United States produces a extensive wind and pressure pattern that is instrumental in transporting humid air northward into the region. Regions of origin include the Gulf of Mexico and the warm ocean waters off the west coast of Mexico.

Its time of onset, strength, trajectory and duration vary from year-to-year, due in part to the changing phases of ENSO. The following set of slides illustrate the different aspects of the American southwest monsoon. A general outlook for this summer’s monsoon will also be provided.

Pattern 1



For the Colorado Front Range, the monsoon season begins, on average, around July 14th and runs through the first week of August.

Typical Summer Monsoon Pattern for the Southwestern U.S.

A typical summer monsoon pattern will consist of a broad upper level ridge of high pressure and relatively light winds aloft over the western continental United States. The ridge axis (dashed blue line on panel 1A) is normally aligned with the Rocky Mountains, extending north from a center of high pressure aloft anchored somewhere over eastern Arizona or New Mexico. This upper level wind and pressure pattern can remain stationary for weeks at a time, with subtle west-east shifts in the upper ridge in response to the occasional formation of low pressure troughs over the Pacific northwest.

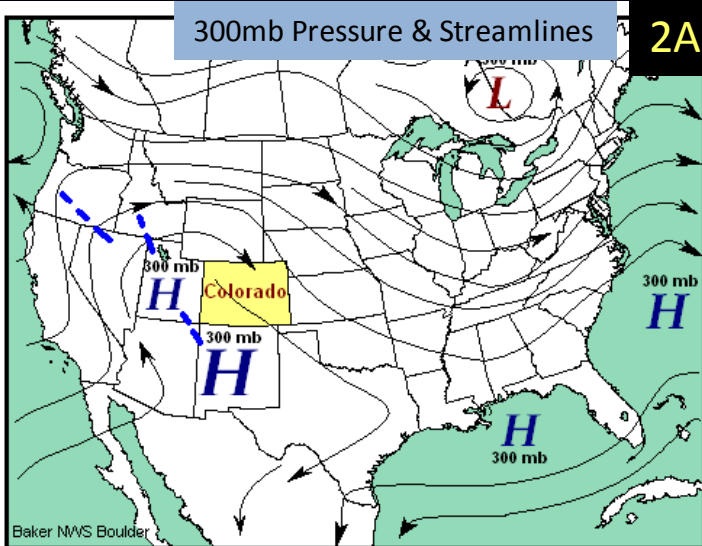
Panel 1B depicts a low atmosphere (850-700mb) wind and pressure pattern associated with a typical southwest summer monsoon. The combined weak circulation around a strong surface high sitting nearly stationary in central or eastern Texas, and a cutoff low (often referred to as a thermal or heat low, and by some researchers as the monsoon low) over southern California or western Arizona, channels humid subtropical air northward into Arizona and New Mexico, normally by the middle of June. This southerly (monsoonal) flow will then gradually transport this plume of moist and unstable air northward into Colorado arriving, on average, by the second week in July. Its arrival is often marked by a rather dramatic increase in afternoon and evening cloud cover and thunderstorm activity, along with an increase in surface dew points and relative humidity.

Pattern 2

Westward Shift in the Southwest Summer Monsoon

300mb Pressure & Streamlines

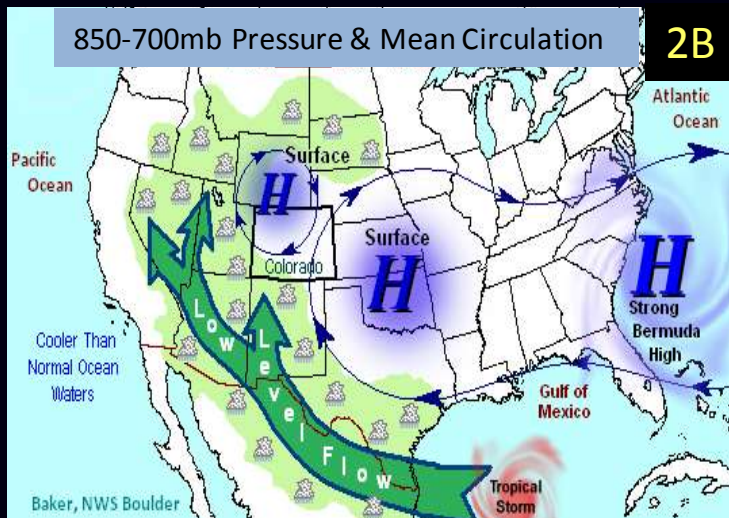
2A



In the aftermath of moderate to strong La Niñas, the American southwest monsoon will often shift west of its normal trajectory over the Four Corners and Rocky Mountain region (Colorado and New Mexico). In panel 2A, note how the prevailing upper level ridge tilts northwest over the central Great Basin from a strong upper level high over New Mexico and/or northern Mexico. This westward shift in the mean ridge positions the central Rocky Mountains and adjacent Great Plains (Colorado, Wyoming, Nebraska and Kansas) under northwest flow aloft for days, if not weeks, at a times. This monsoon pattern can develop several days later than normal and can persist well into late summer or early autumn.

850-700mb Pressure & Mean Circulation

2B



Within the lower atmosphere (850-700mb layer) (panel 2B), the monsoon moisture plume also shifts westward underneath the negatively tilted upper ridge in response to a westward shifting, stronger than normal Bermuda High. Moist subtropical air transported northwestward beneath the upper ridge results in enhanced thunderstorm activity across Arizona, Nevada, Utah and even southern California. Some of this moisture may flow around the top of the Great Basin ridge and over the northern Rockies. Weak shortwaves moving along this flow will merge with this moisture to produce the summertime weather in northeast Colorado described in paragraphs 3 and 4 on the previous slide titled "Setting the Stage for a Drier and Shorter than Normal Monsoon Season."

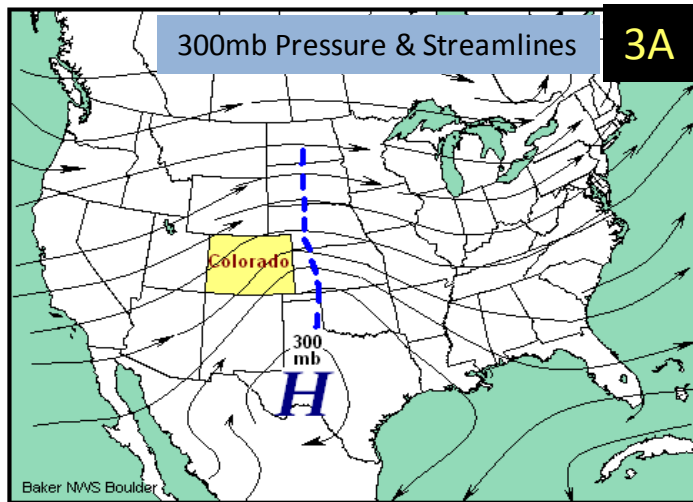
**Odds favor monsoon pattern 2
this summer.**

Pattern 3

Enhanced Summer Monsoon Pattern for Colorado and the Rocky Mountain Region

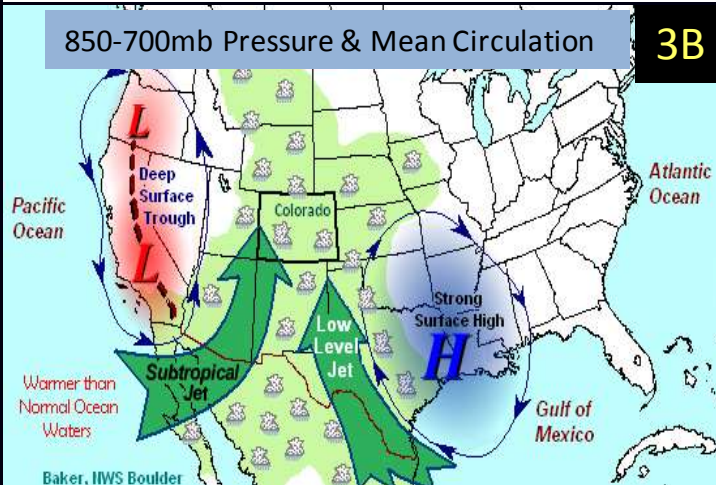
300mb Pressure & Streamlines

3A



850-700mb Pressure & Mean Circulation

3B



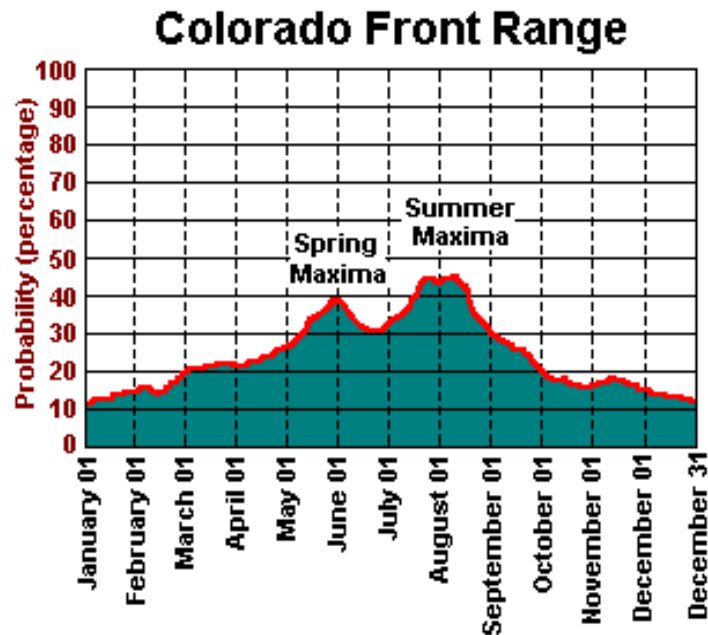
There is a low probability that monsoon pattern 3 will materialize this summer due in part to the lingering influence of last winter's strong La Niña.

Pattern 3 consists of a pronounced upper level ridge/trough pattern over the western U.S. during the summer months more often prior to and sometimes after moderate to strong El Niños. A high amplitude upper level ridge (depicted in panel 3A) can persist up to a couple of weeks at a time over the Great Plains of the U.S. and southern Canada. An unusually deep upper level low pressure trough will also be positioned over the west coast. The mean flow aloft over Colorado is predominantly light in speed and southwesterly in direction.

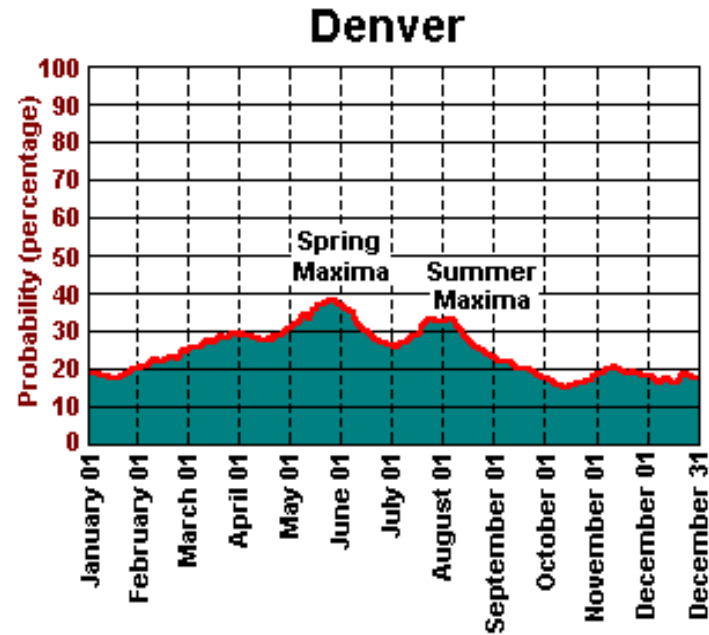
In the lower atmosphere (depicted in 3B), the combined circulation around a strong surface high anchored in the lower Mississippi River Valley and a comparatively strong low pressure trough along the west coast channels waves of moist and unstable subtropical air northward up along the spine of the Rocky Mountains and beneath the upper ridge. Sometimes, additional moisture will be transported up from the tropics (the inter-tropical convergence zone) by a relatively strong subtropical jet stream located about 10,000 to 15,000 ft above the ground. This connection to the tropics further increases the likelihood for heavy rain producing thunderstorms across the desert southwest and Rocky Mountain region, including the Colorado Front Range.

Under these conditions, the monsoon can arrive along the Colorado Front Range as much as a week to 10 days early and linger several days longer than normal.

Probability of 0.01 inch of Precipitation for the Colorado Front Range and Denver



Baker - NWS Boulder

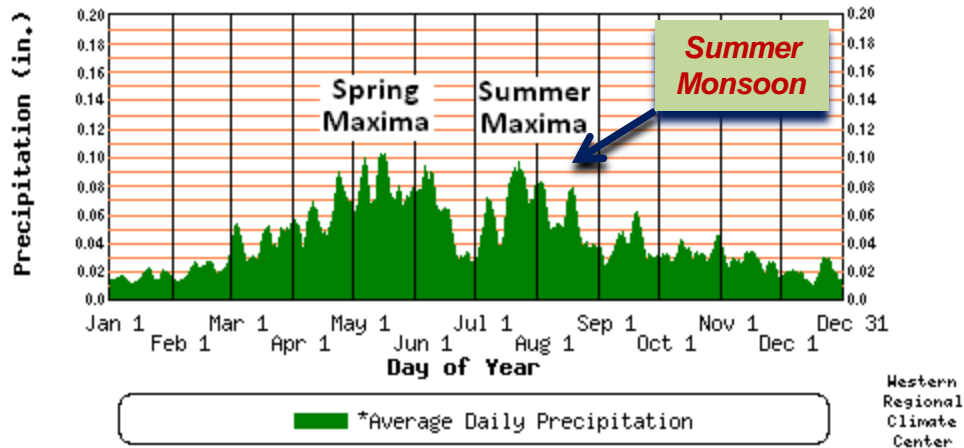


Data Provided by Western Regional Climatic Center

The probability of measurable precipitation (at least 0.01 inch) is greatest for Colorado Front Range mountain locations during the summer and greatest for the Denver area during the spring.

DENVER STAPLETON AP, COLORADO

Period of Record : 8/ 1/1948 to 12/31/2010



* 5 day running average of all daily precipitation recorded for the day of the year.
The day of interest is centered in the running average.

On average, there are two periods of peak precipitation during the year in Denver, Colorado.

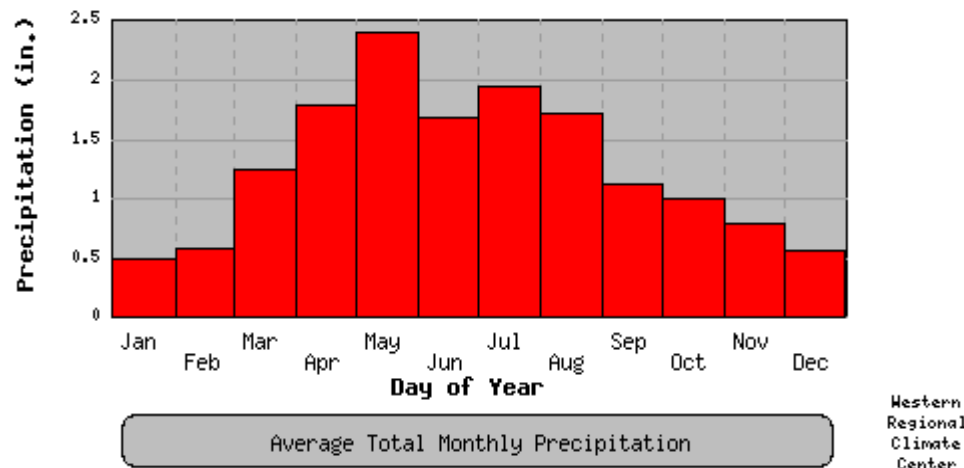
The first peak, or precipitation maxima, occurs in the spring around the second to third week in May.

The second precipitation maxima occurs around the third to fourth week of July. This second maxima falls within a period from around the middle of July through early August, which locals often refer to as the **summer monsoon**.

Average total monthly precipitation is greatest in May for Denver but the chance for **flash flooding** caused by heavy rainfall is greatest during the so-called summer monsoon period, when storm motions are much slower and precipitable water values (total atmospheric moisture) are greater.

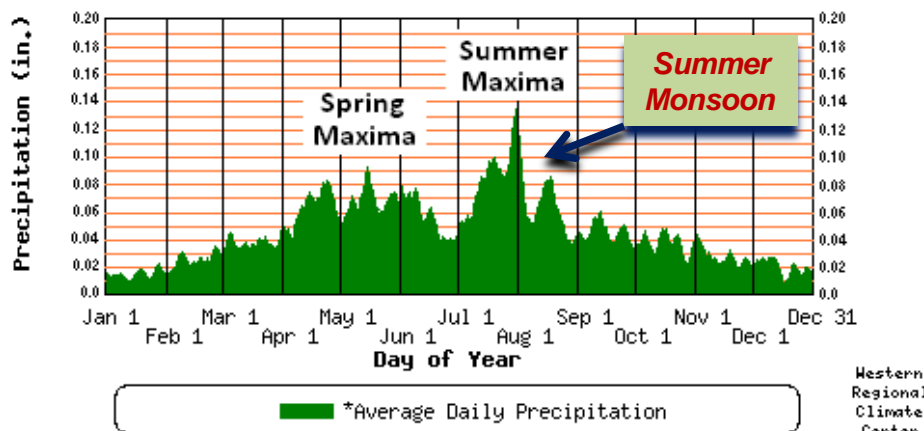
DENVER WSFO AP, COLORADO (052220)

Period of Record : 8/ 1/1948 to 12/31/2010



ESTES PARK, COLORADO

Period of Record : 2/ 1/1896 to 5/31/1994



* 5 day running average of all daily precipitation recorded for the day of the year.
The day of interest is centered in the running average.

The Colorado Front Range locations of Estes Park and Evergreen also experience two periods of peak precipitation, on average, each year.

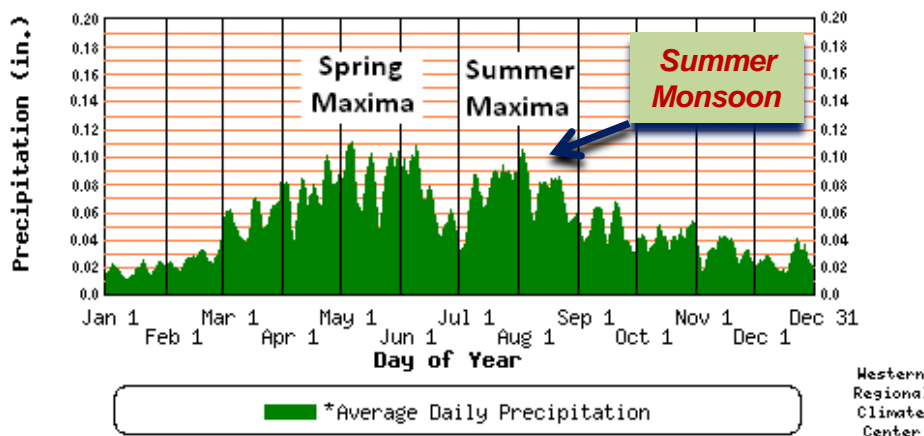
The first precipitation maxima occurs in the spring around the second to third week in May.

A second daily precipitation maxima occurs around the end July. This mid-summer increase in (convective) precipitation occurs during the period often referred to as the **summer monsoon**.

Average daily precipitation is slightly greater during the spring at Evergreen and greatest during the summer monsoon period at Estes Park. However, the chance for flash flooding rainfall from slow moving thunderstorms is greatest during July and August at both locations.

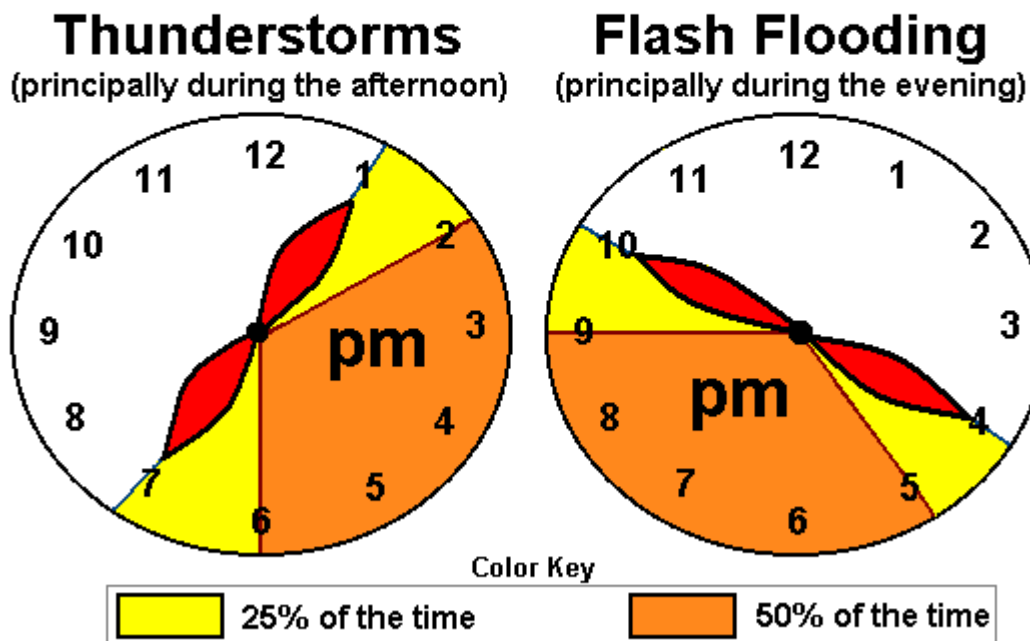
EVERGREEN, COLORADO

Period of Record : 5/24/1961 to 12/31/2010



* 5 day running average of all daily precipitation recorded for the day of the year.
The day of interest is centered in the running average.

Average Occurrence of Thunderstorms and Flash Flooding Along the Colorado Front Range from May through August



Baker - NWS Boulder

Summertime convection (i.e., thunderstorms) in northeast Colorado are more likely to form during the afternoon and will often persist well into the evening on the plains. Storms typically form first over the heated east facing slopes of the Front Range before drifting out over the adjacent high plains during the afternoon and evening hours.

Thunderstorms occur most often along the Front Range, including the Denver area, from 2 pm to 6 pm. However, summertime thunderstorms do occur at *anytime of the day or night*.

Although less frequent during the late afternoon and evening hours, thunderstorms along the Front Range are more prone to produce heavy rainfall resulting in flash flooding because of lighter winds, both at the surface and aloft. This is especially true during July and August.

Influence of Slope and Vegetation on Rainfall Runoff

Exposed rock and soils with sparse vegetation



Baker

Potential for heavy runoff with rainfall rates of less than 1 inch per hour

Shrubs, bushes and tall grasses



Potential for heavy runoff with rainfall rates of 1 to 2 inches per hour

Dense tree stands with thick under brush



Potential for heavy runoff with rainfall rates of 2 to 4 inches per hour

Baker - NWS Boulder

*Never Let Your Guard Down-
Even on Sunny Days!*

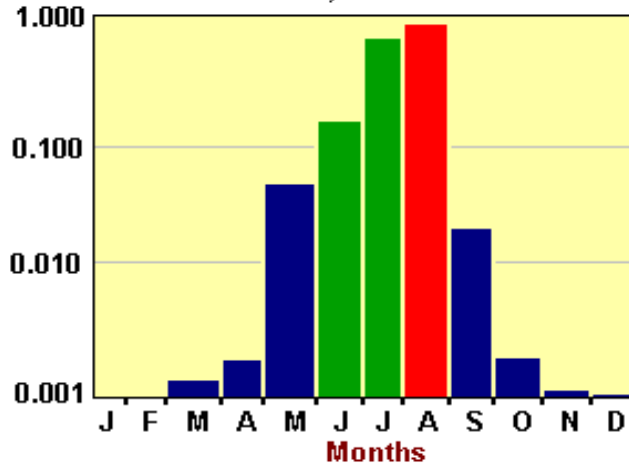


Baker-NWS Boulder

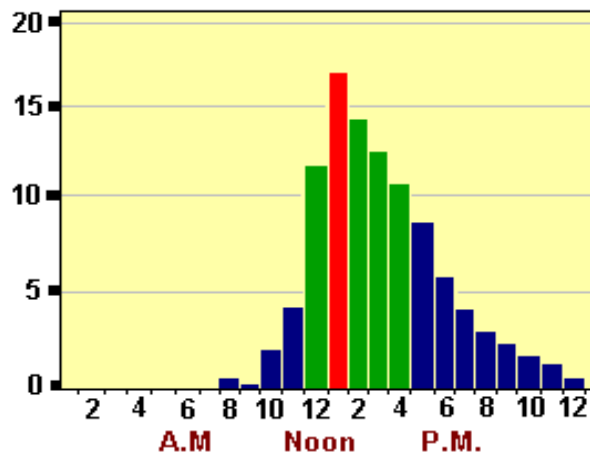
Even though the chance for heavy rainfall is expected to be lower than normal along the Colorado Front Range this summer, one should **never** rule out the possibility of **flash flooding**, particularly in steep mountainous terrain and in areas recently burned over by a wildfire.

The Lightning Threat Along the Colorado Front Range

Mean Monthly Cloud-To-Ground
Lightning Flash Density for
Denver, Colorado



Mean Hourly Cloud-To-Ground
Lightning Flashes per Diurnal
Cycle for Denver, Colorado



Source: NOAA/National Severe Storms Laboratory

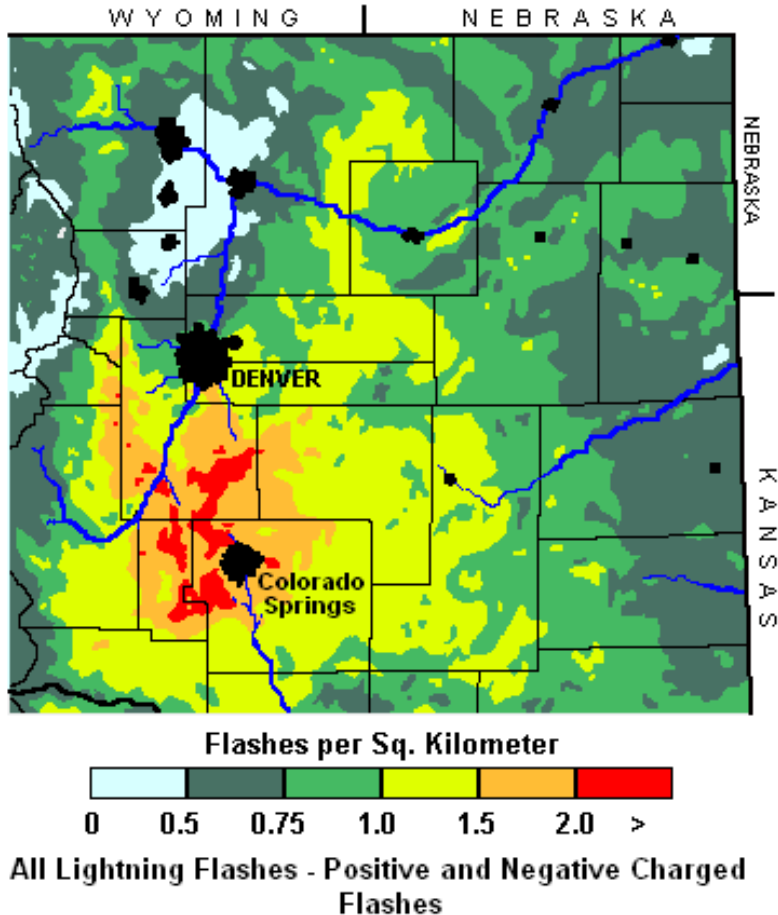
Along the Front Range in northern Colorado, lightning frequency increases steadily during the months of May, June and July, and normally peaks during the month of August.

On average, lightning frequency in the Denver area peaks early in the afternoon with the initial wave of thunderstorms moving off the Front Range. Its frequency will then decrease through the afternoon as thunderstorm activity shifts farther out onto the plains.

Lightning in the Denver area is also more likely to occur later in the day as we move further into summer. This is because of a strengthening temperature inversion aloft that can delay and even inhibit the formation of a thunderstorm.

One of the Most Active Areas for Lightning in the United States

Mean Density for All Lightning Flashes in Northeast Colorado May-July 1989-1999



Source: The Lightning Project at Texas A&M University 2000

The Lightning Project conducted by Texas A&M University in 2000 revealed that cloud-to-ground lightning strokes were most likely to occur over the elevated terrain known as the Palmer Divide located between Denver and Colorado Springs. The greatest occurrence of all lightning flashes was recorded around Colorado Springs. This is also an area of high hail occurrence.

This study, covering ten years of lightning flashes (both positively and negatively charged strokes), also revealed an area of unexpectedly low lightning activity along the northern Front Range around the cities of Longmont, Loveland, Fort Collins and Greeley. No clear explanation was offered for the lack of lightning activity in this area.

Drought and Wildfires In a Post La Niña World



As of late June, the risk of wildfire remains high to extreme for much of Colorado.

U.S. Drought Monitor

Colorado

June 21, 2011

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	59.62	40.38	31.54	25.86	11.95	0.91
Last Week (06/14/2011 map)	58.84	41.16	31.89	26.50	13.01	0.91
3 Months Ago (03/22/2011 map)	40.99	59.01	52.02	39.60	0.00	0.00
Start of Calendar Year (12/28/2010 map)	40.40	59.60	49.57	10.13	0.00	0.00
Start of Water Year (09/28/2010 map)	28.86	71.14	10.70	0.00	0.00	0.00
One Year Ago (06/15/2010 map)	84.38	15.62	0.00	0.00	0.00	0.00

Intensity:

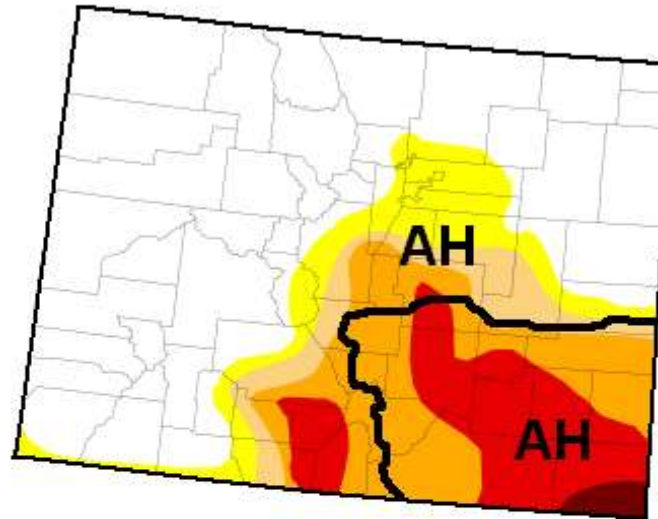
 D0 Abnormally Dry	 D3 Drought - Extreme
 D1 Drought - Moderate	 D4 Drought - Exceptional
 D2 Drought - Severe	

Drought Impact Types:

 Delineates dominant impacts

A = Agricultural (crops, pastures, grasslands)

H = Hydrological (water)



Released Thursday, June 23, 2011
Brian Fuchs, National Drought Mitigation Center

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. See accompanying text summary
for forecast statements.

<http://drought.unl.edu/dm>

As of June 21, 2011, severe (D2) to extreme (D3) drought conditions existed across nearly all of southeast Colorado, with exceptional drought conditions (D4) in the far southeast corner of the state. Abnormally dry (D0) to moderate drought (D1) conditions exist in portions of northeast Colorado, including the Palmer Divide and along the New Mexico border in southwest Colorado. Drought conditions were not as yet indicated in the rest of the state.

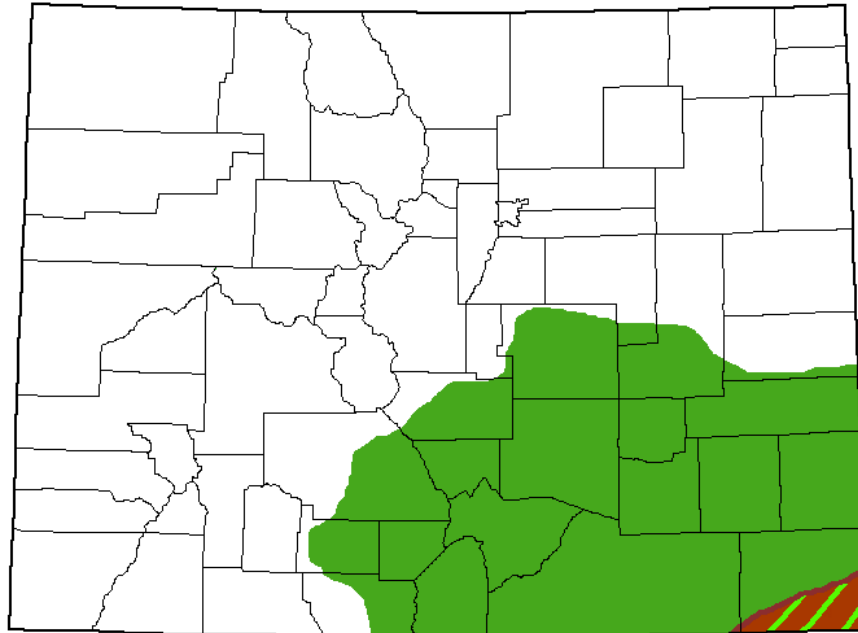
Greatest impacts due to these drought conditions were to agriculture (A) and water (H) managers and users.



Colorado Seasonal Drought Outlook

Drought Tendency During the Valid Period

June 16 to September 30, 2011



Released Thursday, June 16, 2011

Author: Brian Fuchs, National Drought Mitigation Center

KEY:

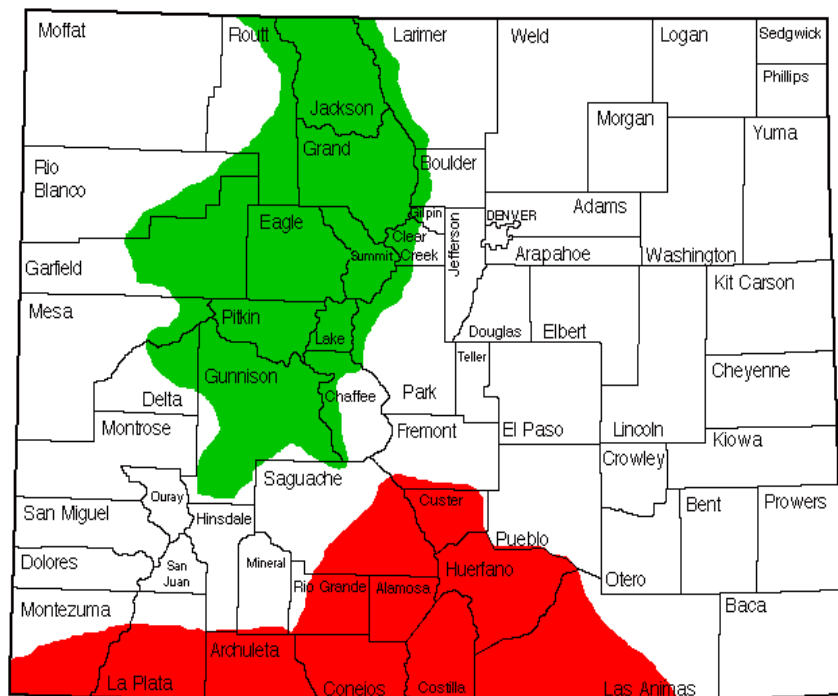
-  Drought to persist or intensify
-  Drought ongoing, some improvement
-  Drought likely to improve, impacts ease
-  Drought development likely

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events--such as individual storms--cannot accurately forecast more than a few days in advance. Use caution for applications--such as crops--that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. Note: the green improvement areas imply at least 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

The seasonal drought outlook issued by Brian Fuchs with the National Drought Mitigation Center calls for drought conditions to likely improve across southeast and south central Colorado now through the end of September of this year.

However, the exceptional drought conditions in the extreme southeast Colorado will be slowest to improve.

Seasonal Significant Wildland Fire Potential Outlook For Colorado July to September 2011



Significant Fire Potential



Significant fire potential is the likelihood that a wildland fire event will require mobilization of additional resources from outside the area in which the fire situation originates.



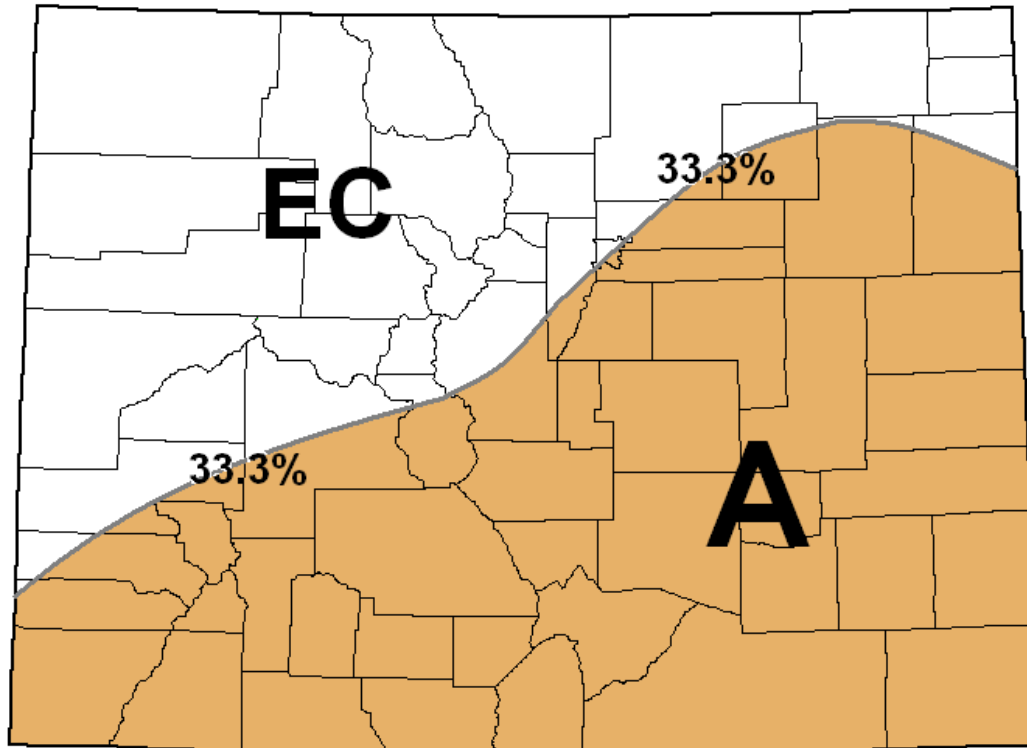
Map produced by
Predictive Services,
National Interagency
Coordination Center
Boise, Idaho
Issued June 1, 2011
Next issuance July 1, 2011

The latest Seasonal Significant Wildland Fire Potential Outlook, issued by NIFC's Predictive Services, calls for a continuation of above normal significant fire potential across portions of southern Colorado through September. This includes the San Luis Valley, the Sangre de Cristo Mountains and nearby plains.

Meanwhile, a below normal risk of significant wildfire will persist over the mountains and on the Valley floors in northern and central Colorado.

**July-September 2011
Temperature and Precipitation
Composites and Outlooks
for Colorado
From NOAA's
Climate Prediction Center**

July 2011 Temperature Outlook for Colorado



One-Month Outlook
Temperature Probability
0.5 Month Lead
Valid July 2011
Made: 16 June 2011

A Means Above Normal (Average)
N Means Normal (Average)
B Means Below Normal (Average)
EC Means Equal (or Undetermined)
Chances for A, N and B

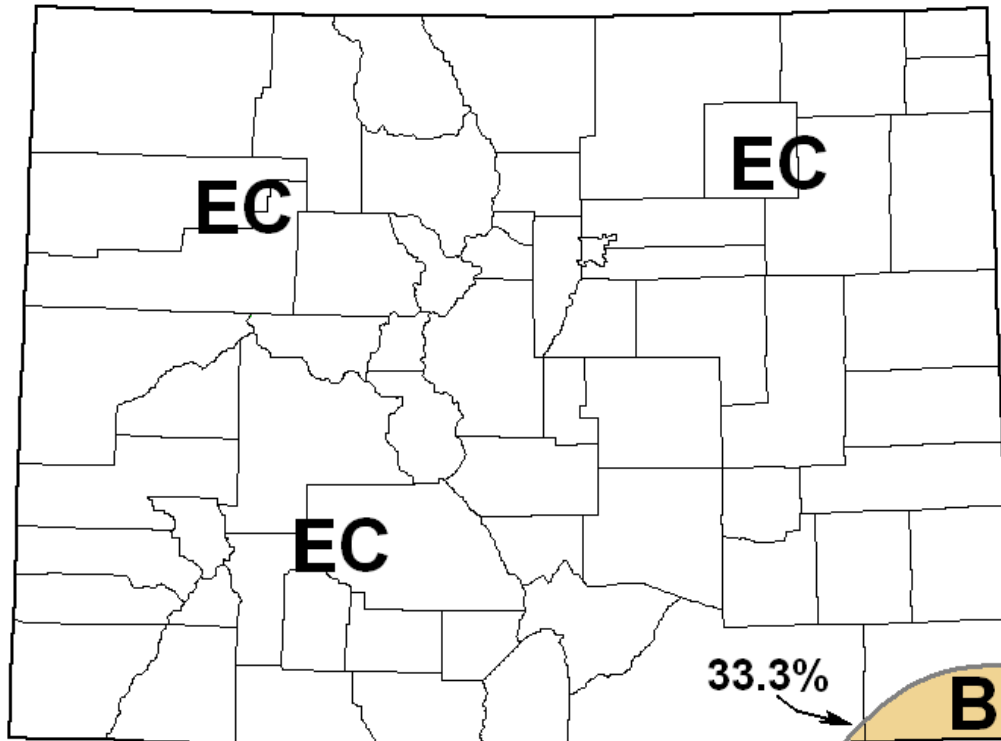
Source: NOAA/Climate Prediction Center

July 2011 Temperature Outlook For Colorado

The latest outlook from the Climate Prediction Center (CPC) calls for at least a 33 percent chance for above average temperature across the southeastern two-thirds of Colorado during the month of July.

The temperature outlook for the remainder of Colorado is less certain as indicated by the EC designation.

July 2011 Precipitation Outlook for Colorado



One-Month Outlook
Precipitation Probability
0.5 Month Lead
Valid July 2011
Made: 16 June 2011

A Means Above Normal (Average)
N Means Normal (Average)
B Means Below Normal (Average)
EC Means Equal (or Undetermined)
Chances for A, N and B

Source: NOAA/Climate Prediction Center

July 2011 Precipitation Outlook For Colorado

The outlook for July calls for at least a 33 percent chance for below average precipitation in the extreme southeast corner of Colorado.

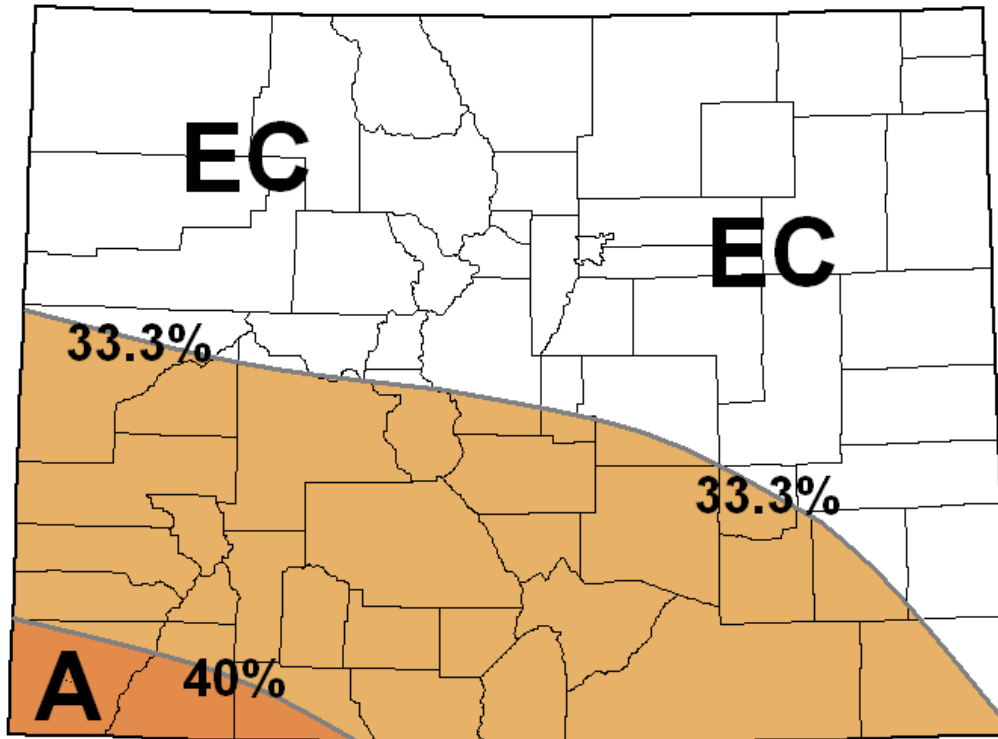
The outlook for the remainder of the state is less certain as indicated by the EC designation.

July, August and September 2011 Temperature Outlook for Colorado

Calls for better than a 33 percent chance for above average temperature across the southwest one-third of Colorado, with a greater than 40 percent chance for above average temperature in the extreme southwest corner of the state.

The outlook for the rest of Colorado is less certain, calling for an equal chance for above, below and average temperatures as designated by the EC symbol.

July-August-September 2011 Temperature Outlook for Colorado

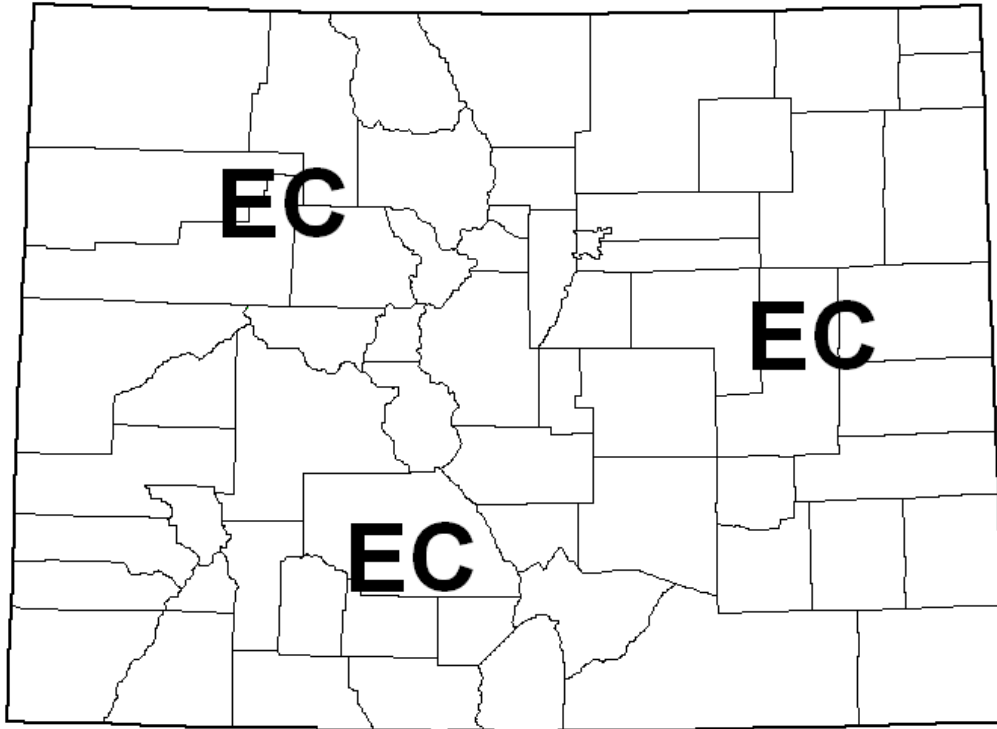


Three-Month Outlook
Temperature Probability
0.5 Month Lead
Valid JAS 2011
Made: 16 June 2011

A Means Above Normal (Average)
N Means Normal (Average)
B Means Below Normal (Average)
EC Means Equal (or Undetermined)
Chances for A, N and B

Source: NOAA/Climate Prediction Center

July-August-September 2011 Precipitation Outlook for Colorado



Three-Month Outlook
Precipitation Probability
0.5 Month Lead
Valid JAS 2011
Made: 16 June 2011

A Means Above Normal (Average)
N Means Normal (Average)
B Means Below Normal (Average)
EC Means Equal (or Undetermined)
Chances for A, N and B

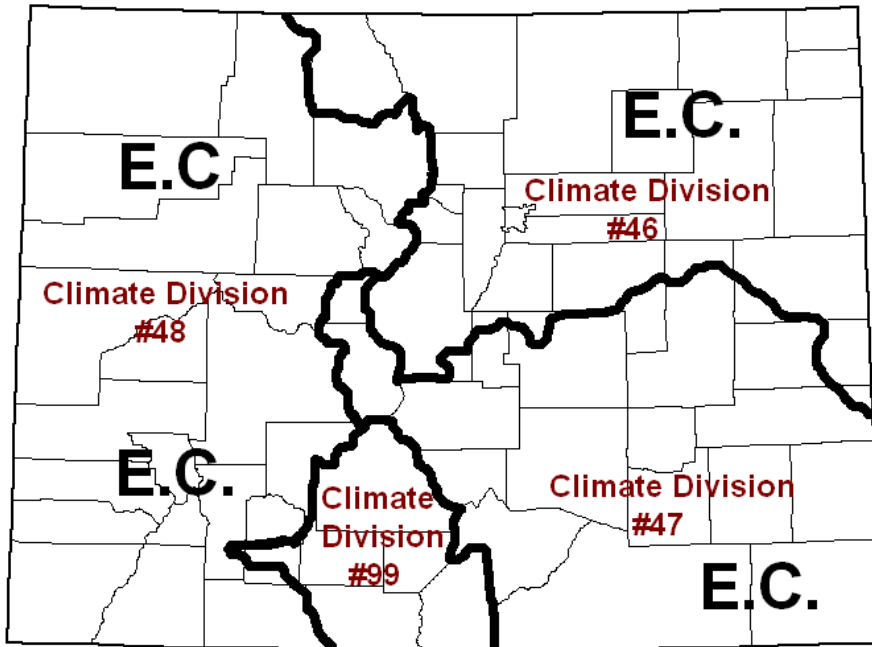
Source: NOAA/Climate Prediction Center

July, August and September 2011 Precipitation Outlook for Colorado

The latest outlook calls for an equal or undeterminable chance for above, below and average precipitation across the entire state, as indicated by the symbol EC.

Adding Value to An “EC” Outlook from CPC

September-October-November Precipitation Outlook
for Colorado



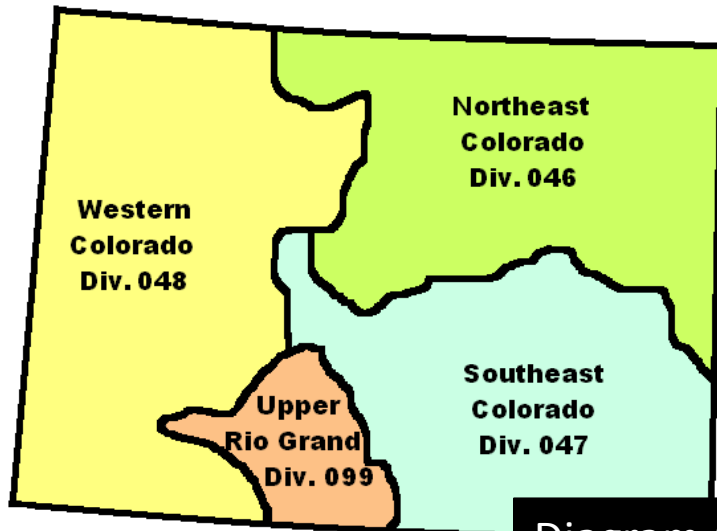
Three-Month Outlook
Precipitation Probability
0.5 Month Lead
Valid SON
Made: xxxxxx

A Means Above Normal (Average)
N Means Normal (Average)
B Means Below Normal (Average)
EC Means Equal (or Undetermined)
Chances for A, N and B

Climate outlooks issued by the Climate Prediction Center (CPC) will often indicate an equal or undeterminable (EC) chance for above, below and average temperature or precipitation outlook for a region. An EC outlook by itself provides little indication for a particular trend in temperature and precipitation for a given season.

However, to add some value to an “EC” outlook, one can refer to temperature and precipitation composites prepared by CPC for every climate division in the United States. These composites provide the user with a historical perspective of how temperatures and precipitation have trended during El Niño, ENSO-neutral and La Niña conditions.

Colorado Climate Divisions



NOAA/Climate Prediction Center

Diagram A

Diagram A: Colorado is sub-divided into four climate divisions. Climate divisions 046, 047 and 099 are located east of the Continental Divide, and division 048 west of the Divide.

NOAA's Climate Prediction Center (CPC) has produced historical distributions of 3-month temperature and precipitation associated with three different ENSO categories – El Niño, La Niña and neutral (non-ENSO) events – for each of climate division.

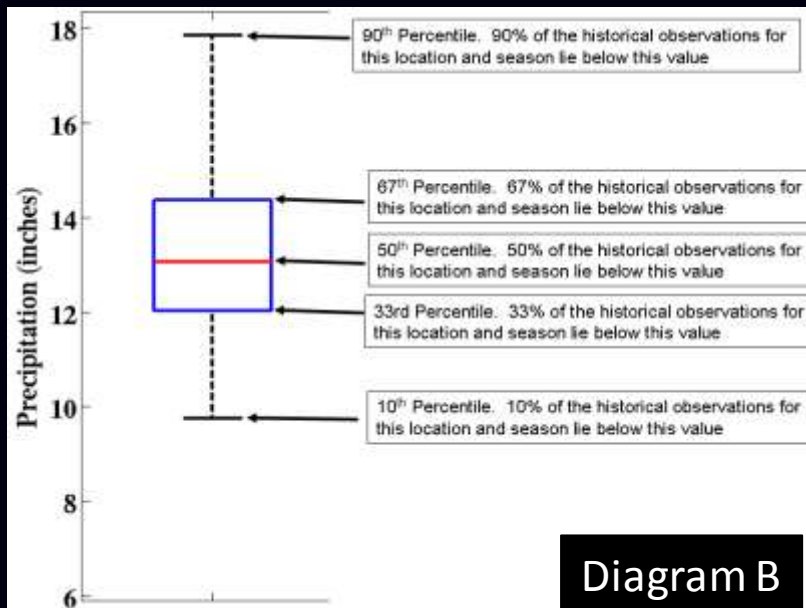
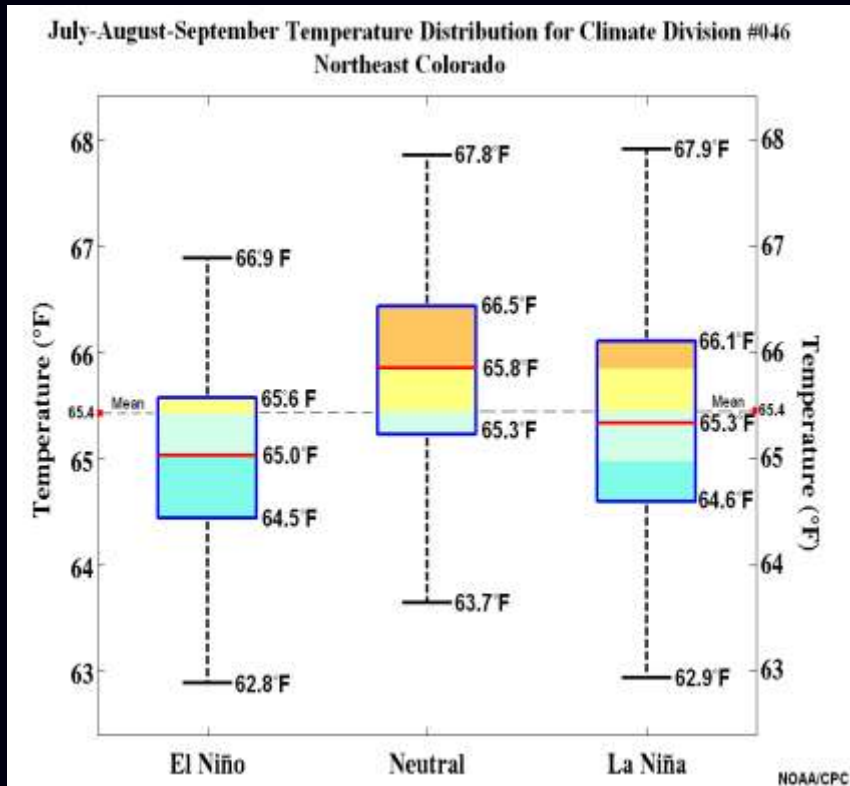


Diagram B

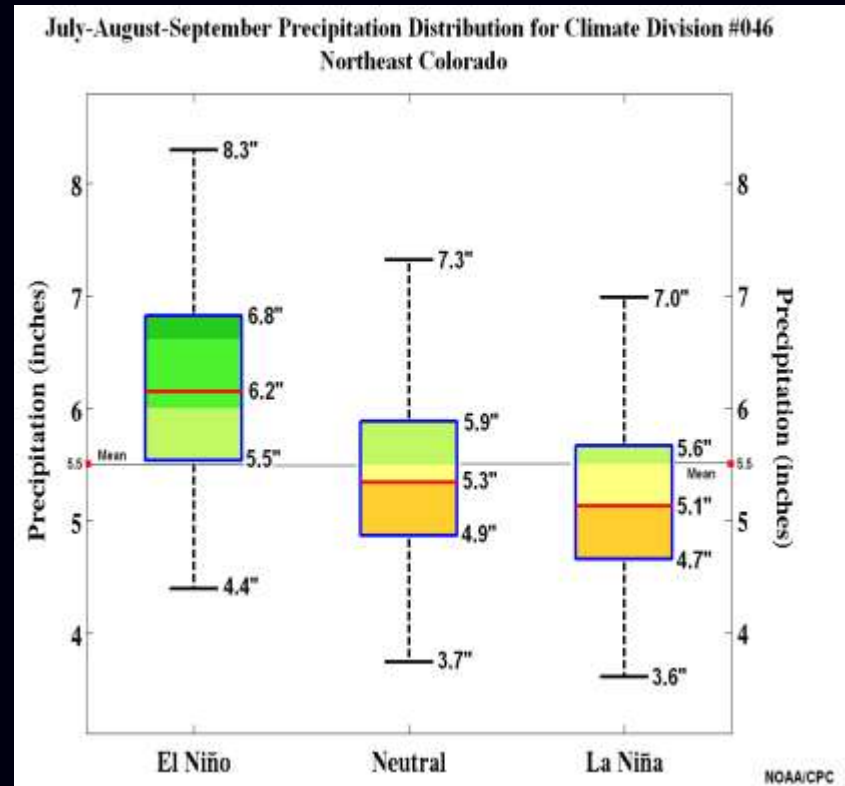
Diagram B: These historical temperature and precipitation distributions can be viewed using an ENSO box and whisker analysis plot (explanation to the left).

The red line inside the ENSO box represents the mean or 50th percentile of the data (temperature or precipitation) distribution. Approximately 34% of the total observations exist within the ENSO box, and the remaining observations (or 66%) outside of the box.

ENSO Box and Whisker Analysis Plots for the Northeast Colorado Climate Division #046 for the 3-Month Climate Season July-September 2011

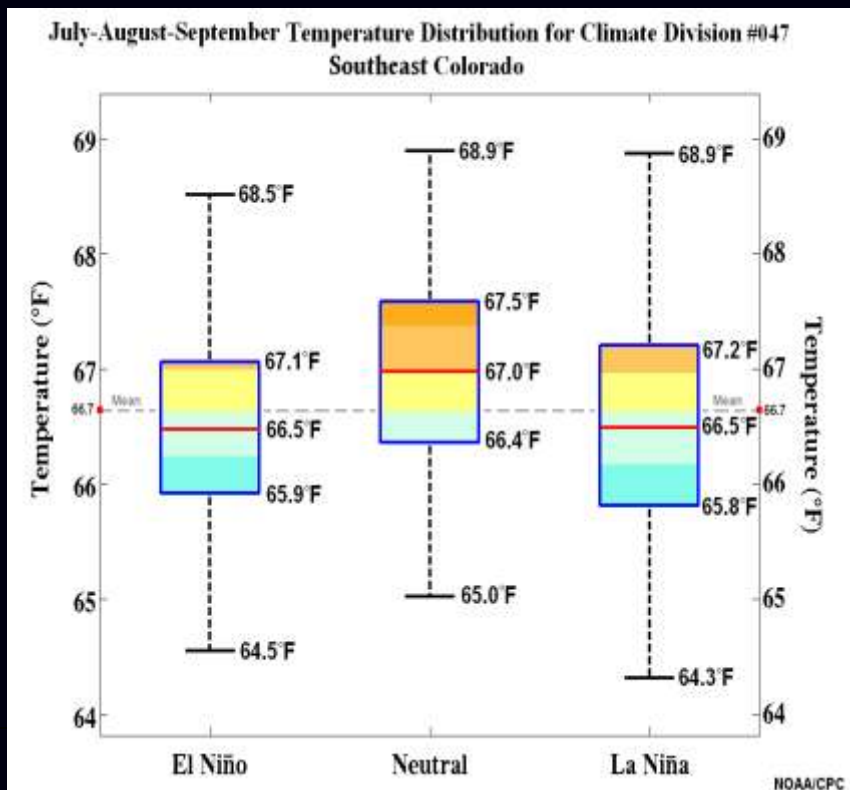


According to CPC's three-month temperature distribution composite, northeast Colorado historically experienced **average to slightly below average temperatures** when La Niña conditions exist during this period. It is believed that a La Niña temperature distribution will prevail.

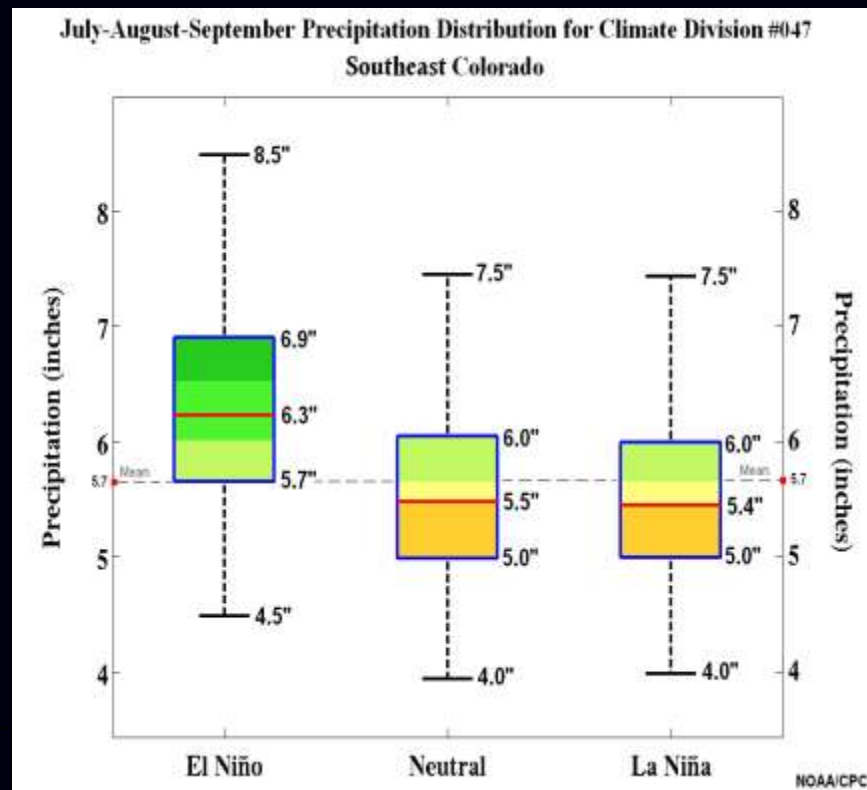


According to CPC's three-month precipitation distribution composite, northeast Colorado historically experienced **below average precipitation** when La Niña conditions exist during this period. It is believed that a La Niña precipitation distribution will prevail.

ENSO Box and Whisker Analysis Plots for the Southeast Colorado Climate Division #047 for the 3-Month Climate Season of July-September 2011

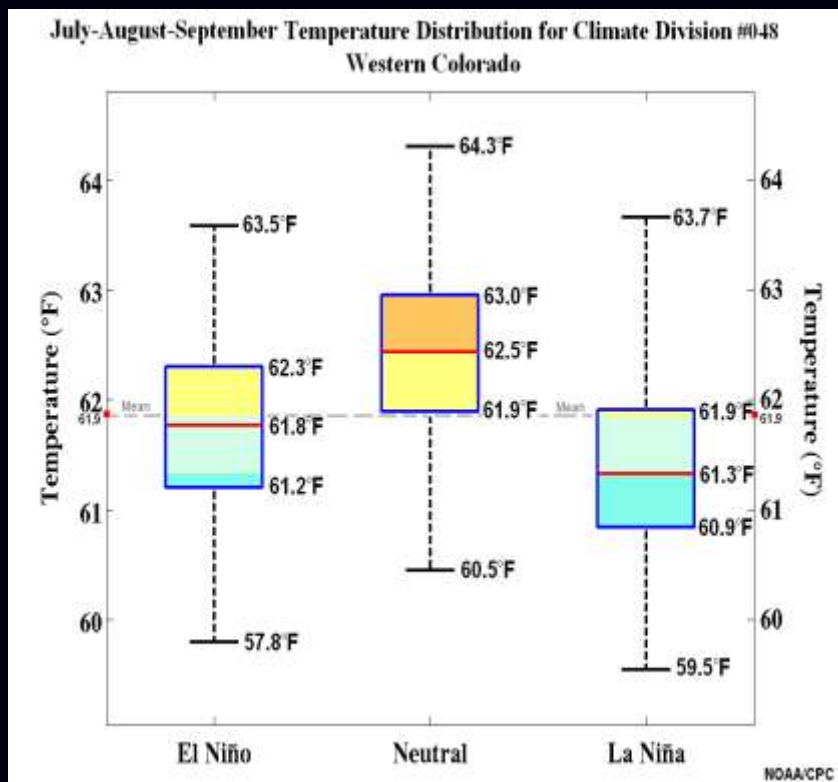


According to CPC's three-month temperature distribution composite, southeast Colorado historically experienced **average to slightly below average temperatures** when La Niña conditions exist during this period. It is believed that a La Niña temperature distribution will prevail.

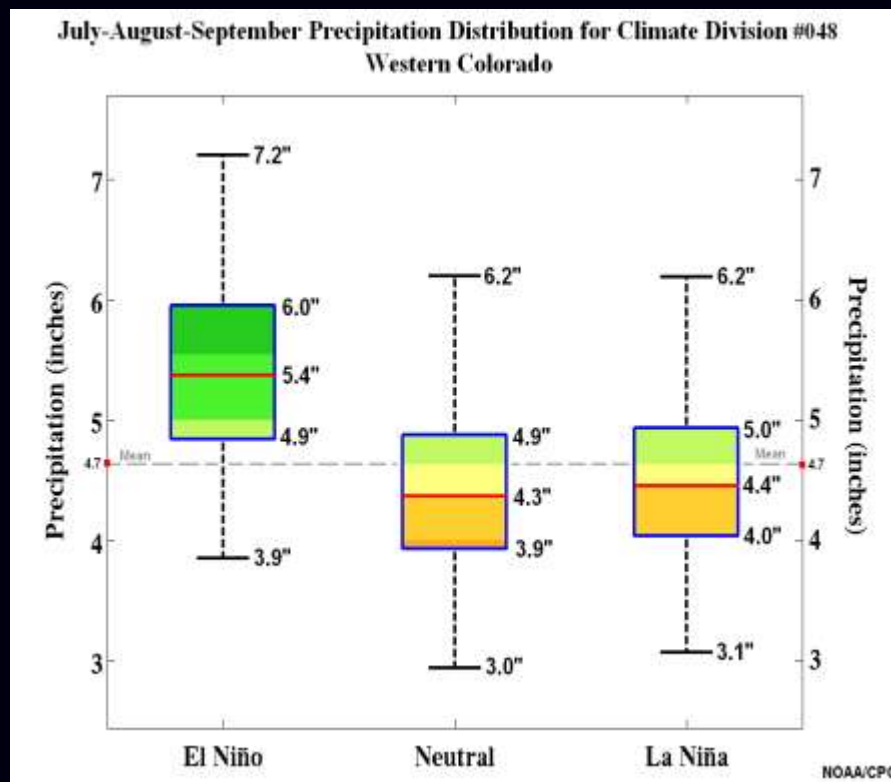


According to CPC's three-month precipitation distribution composite, southeast Colorado historically experienced **average to slightly below average precipitation** when La Niña conditions exist during this period. It is believed that a La Niña precipitation distribution will prevail.

ENSO Box and Whisker Analysis Plots for the Western Climate Division #048 for the 3-Month Climate Season of July-September 2011



According to CPC's three-month temperature distribution composite, western Colorado historically experienced **below average temperatures** when La Niña conditions exist during this period. It is believed that a La Niña temperature distribution will prevail.



According to CPC's three-month precipitation distribution composite, western Colorado historically experienced **average to slightly below average precipitation** when La Niña conditions exist during this period. It is believed that a La Niña precipitation distribution will prevail.